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[OFFICIAL NOTICE.]

Twelfth Annual Meeting Western Gas Association.

SECRETARY'S OFFICE, WESTERN GAS ASSOCIATION,
QUINCY, ILLS., May 11, 1889.

The Twelfth Annual Meeting of the Western Gas Association will be held at Cincinnati, Ohio, on the 15th, 16th and 17th days of May. The "Grand" which has been secured by the local Committee of Arrangements for our headquarters, has been lately refitted, as well as greatly improved in all respects, and is now one of the finest hotels in the country. The business sessions of the Association will be conducted in a large room within the hotel building, and for quiet, comfort and coziness, the arrangement is all that could be desired. The hotel rates have been reduced to $3 per day to the members of the Western Gas Association and their guests. It may be well to bear in mind that the Grand Hotel is but one block away from the Grand Central Railway Depot, at which place about all the delegates to attend the convention will arrive. The convenience of this speaks for itself.

A reduction in transportation rates has also been secured, for those who will be in attendance, in the territory of the Central Traffic Association, which is bounded on the East by Pittsburgh, Buffalo and Toronto; on the North by the line of, and including points on the Grand Trunk Railway, from Toronto to Port Huron, thence via Lakes Huron and Michigan to the North line of Cook County, Illinois; on the West, by the West line of Cook County and the Illinois and Mississippi rivers to Cairo, including Burlington, Keokuk, Quincy, Hannibal and St. Louis; and on the South by the Ohio river. As promised in my earlier notices, the necessary information as to the manner and method of obtaining the concession in railway rates, has been mailed to each member.

I am gratified to be in position, owing to the courtesy and promptness with which the contributors of papers have responded to my appeal for the titles of their essays, to present the following index to the literary treat that is in store for the members. The list is appended:

"Meter Accounting: Do I lose any Meters?" by G. A. Hyde, Jr.
"On the Use of Crude Oil for Firing Bench Furnaces and Enriching Coal Gas," by J. H. Woodmansee.
"Incandescent Gas Lighting," by John McIlhenny.
"Inclined Retorts," by R. D. Walsh.
"Retort House Work," by Geo. T. Thompson.
"Retort Furnaces for Burning Coal," by K. M. Mitchell.
"Fuel Gas," by Chas. R. Faben, Jr.
"Points on the Management of Small Gas Works, as Deduced from Twenty-five Years Experience," by L. P. Gerould.
"The Education of the Gas Engineer," by John Gimper.

Mr. Walter L. Brown, who is now in charge of the works at Evanston, Ills., has given a conditional promise of a paper, in which he proposes to deal with "A Winter's Experience with a Springer Plant."

In addition to the above alluring array of subjects, our gifted Honorary Member, Prof. T. C. Mendenhall, of Terre Haute, Ind., has kindly consented to favor us with a lecture on the "Nature of Light." As the members of our Association ardently desire to absorb all the information that there is to be had on this very subject, it is safe to promise the genial Professor an attentive audience.

There has been a very strong undercurrent of sentiment all drifting in

the direction of causing the "Question-Box" to assume a more prominent part in the Cincinnati convention than that hitherto played by this important and useful receptacle. In order that a systematic and comprehensive arrangement and classification of the questions be assured, the members can greatly aid the Secretary should their queries be immediately forwarded to him at Quincy.

To go back a step, it might be well to call attention to the advisability, if not the necessity, that exists for members seeing to it that their rooms in the hotel are secured at a day in advance of the meeting. The Grand is a large hotel, it is true; but as every holder has a limit beyond which it is not safe to go, and as the Western is fast becoming a "big Association," our members should give due heed to the above hint, in order that disappointment as to proper accommodation may not be experienced by any.

While there really seems no occasion to state that our local Committee of Arrangements are working with good will and strong purpose in their preparations for the Association's entertainment, it gives me pleasure to be able at this early date to furnish the members with a partial list of the good things in store for them. There will of course be a banquet served in the superlative style of the present proprietors of the Grand, carriages are to be at the command of the ladies accompanying the delegates, and other preparations for their entertainment while their escorts are attending the regular business sessions of the Association, are under way. Another feature of the "outing time" will be a steamboat excursion on the Ohio river, the route of which will enable the excursionists to make a visit of inspection to the model East End Station of the Cincinnati Gas Light and Coke Company.

The Western hereby formally extends a most cordial welcome to the Eastern fraternity, and to all others, to be present on the occasion of our Twelfth Annual. Numbers will not interfere with us in the least. In fact, our pleasure and satisfaction will increase in measure with the individual responses, made in person, that shall be our portion from this invitation. We not only earnestly desire, but confidently look forward to meeting this time with a larger delegation from the East than it has been our pleasure to have entertained at any other of our gatherings.

Copies of our by-laws, containing our membership list and application blanks for those who wish to swell the ranks of the "Western," will be mailed by the Secretary to those who desire them.

In accordance with the plan outlined in the last issues of the JOURNAL, to the effect that special arrangements were in process of perfection to enable those who desired to travel in special cars, from Chicago to Cincinnati, on the evening of May 13th, it may be said that those who desire to avail themselves of this programme should purchase tickets by the "Monon route." Fred R. Persons, 75 North Clinton street, Chicago, should be notified of this intention at as early a date as possible, so that provision can be made for the accommodation of all.

A. W. LITTLETON, Secretary.

[Prepared for the JOURNAL.]

The Measurement of the Candle Power of Electric Street Lights.

By PROF. J. T. STODDARD, Smith College, Northampton, Mass.

In measuring the candle power of electric street lights while burning in their position on the street, one has certain difficulties to contend with which are absent in ordinary photometric measurements. The chief of these difficulties lie in the facts that the lamp to be tested is at a considerable height above the horizontal plane which the photometer can in most cases conveniently occupy, and that the work must be done out of doors. In compliance with the request of the Editor of the JOURNAL, I will briefly describe the way in which I have sought to solve the problem which presents itself.

In the first place, the photometer must be modified so that the light coming from a point considerably above its plane shall yield a beam parallel to the bar. This may be done in two ways:

First.—By having the photometer bar horizontal, as usual, and placing at one end of it a reflector, which shall throw the beam from the electric light along the bar. This reflector must, of course, be a plane surface, and may be an ordinary mirror, or a totally reflecting prism.

Second.—By inclining the bar in the vertical plane so that it shall point directly at the lamp. Of these two methods I prefer the latter, because the use of a reflector of any sort involves loss of some light, the amount of which must be carefully determined and introduced as a correction in the final calculation, while it offers no advantage over the direct method to compensate for the greater trouble and liability of error in the results.

In the second place, a direct measurement of the distance from the arc to the Bunsen screen is in general not easy, and the modified photometer should provide some way for its indirect, and, at the same time, accurate determination.

Thirdly, the photometric work must be done in the open air, and in a number of more or less widely separated places on the same evening. The photometer must, consequently, be readily portable, and at the same time must be provided with a special lantern to protect the standard light from draughts, and with screens to cut off all extraneous light.

To meet these points I have constructed my photometer as follows. The graduated bar is fastened by a pin passing through one end to the edge of a thick board which serves as the base of the instrument. On this pin it moves freely in a vertical plane. At a convenient distance from the pivoted end a graduated circular arc, of some 50°, is attached to it in such a position that when the bar is raised the arc plays in a slot in the edge of the base board. By means of a thumb-screw the arc can be clamped to the base at any point, and thus serve both as a support for the bar at any angle above the base and as a means for determining this angle by the reading of the graduation. The base has fastened to it a carefully-adjusted level. The lantern containing the standard light is mounted on the base just beyond the pivoted end of the bar. When a measurement is to be made the photometer is first brought into the same vertical plane with the electric lamp, and the base accurately leveled. The bar is then raised until it points directly at the lamp, and clamped in this position. The carrier with its Bunsen screen is then mounted on the bar together with blackened diaphragms, which serve to cut off all light except that coming from the standard and the lamp to be tested. If the night is a dark one, and other lights not too near, no further precautions in the way of screens are necessary; otherwise, the photometer is mounted in a covered wagon.

After the readings have been made [giving the distances of the Bunsen screen from the zero mark at the pivoted end of the bar], the horizontal distance from the zero mark to a point vertically beneath the electric light is measured, and the angular elevation of the photometer bar is read on the graduated arc. From these data the direct distances from the screen to the electric light are readily calculated. The corresponding distances from the screen to the standard are obtained afterward by placing the bar at the angle noted and measuring directly from the screen [at its reading] to the point which the standard occupied in the out-door work.

Some Facts and Figures about Coal Gas Enriched with Oil; with Notes on the Value of Oil.

By FREDERIC EGNER.

We have used oil as an enricher of coal gas for about five years. During that time we have had trials with crude petroleum from the Lima and other fields, crude and refined naphtha, and the intermediate distillate, and obtained good results from all of them, used as an enricher; but as one of our objects in using oil was not only to increase the illuminating power of the gas from coal, but also to neutralize the action of naphthaline—which we produced in large quantities—we found that neither crude petroleum nor the intermediate distillate would answer the purpose, although both were very good as enrichers only; and after many tests we at last found that so-called "gas naphtha"—a very light yellow oil, 63° Beaume, at 60° F., and weighing 6.12 lbs. per gallon—was the best for our way of working. It may be remarked that should the enriching of coal gas be done by means of carbureted water gas, then (in the experience of the writer) the crude or intermediate distillate oil will be more desirable than the naphtha described above. But we run the oil into clay retorts, and the resultant vapors mix with the coal gas in the hydraulic main, and go on through all the succeeding apparatus together to the holders. One result is that we have absolutely no trouble with naphthaline at the works, nor in the streets and services; whereas, before using the oil, and with the same kind of coal and method of working, these stoppages were of frequent occurrence at the works, and a source of considerable expense in the streets.

A description of the method in use at our works for converting any oil into gas was published in the AMERICAN GAS LIGHT JOURNAL, Jan., 1887, a table of results having been published in the JOURNAL, issue of Dec. 16, 1886. The following data, however, are the averages of the total results of the twelvemonths ending May 1, 1889. We know that European gas companies do not object to give the results of their operations to the world—as witness Field's Analysis of Gas Companies' Accounts, published annually; but as in this country it is considered undesirable to do so, the author therefore gives only the averages of the totals of the material and products with which we have to deal. It may, however, inspire confidence in the figures given when it is understood that the gas made in the time specified, at the works under the

direction of the writer, *exceeds by many millions* the sum of 300 million cubic feet; that the coal used was *much more* than 30,000 tons, and the oil *more than* 300,000 gallons.

The oil has been described above. We used only one kind of oil and coal during the year. The coal used was Youghiogheny coking coal, and, on trials, produced from 4.89 to 4.90 cubic feet of 16 to 17 candle gas.

All the gas made is registered by station meters built by the American Meter Company, and fitted with constant overflow gauges, so that the water line cannot get too high. The photometer used in testing the illuminating power is a Bunsen bar, made by the Goodwin Gas Stove and Meter Company, and the burner used is Sugg's London Argand, No. 1.

We clean up the coal pile every season; and, starting with the season's supply twelve months ago, we found on the morning of the 1st of May just passed that the last year's coal has overrun by a number of thousands of bushels, and that my results cannot, therefore, be said to have been obtained at the expense of a shortage in the coal. Our oil storage capacity is so limited that we know from day to day what we have used and on hand.

Our retorts are ⏢ shaped, 2 ft. 3 in. by 14 in. by 8 ft. 3 in., inside measure, heated still by means of the old-style of bench furnace—the only old-fashioned thing at the works; and that is certainly not the writer's fault. The proportion of oil retorts to coal retorts in use is about 1 oil to 30 or 32 coal retorts. One oil retort can easily take care of 10 gallons of oil per hour, or 240 gallons in 24 hours. If crude petroleum is used, 8 gallons per hour is all that can be properly worked off per retort. The oil retorts are not in benches by themselves, but—and it is far better so to do—are distributed, one oil retort to a bench up to the number required. The bench may be fired as hard as the man is able to do it; the heat of the oil retort is easily regulated by the amount of oil run into it. The results hereinafter stated could not be obtained if the oil retorts were all in a bench or benches by themselves. The result of a year's work was as follows:

We used 10.99 gallons of oil to each ton (2,240 lbs.) of coal, and produced, with this mixture and proportion, 12,432 cubic feet of 20.20 candle gas; or 5.55 cubic feet per pound of coal carbonized. If we take 4.90 cubic feet of 17 candle gas as the average yield per pound of coal, although that was the maximum yield when operating with the coal alone, we find that one ton of coal produced 10,976 cubic feet of 17 candle gas. It would seem to be perfectly logical to credit the increased yield and illuminating power of the gas noted to the oil that was used, since, without using the latter, the increase could not be obtained. Subtracting 10,976 (the cubic feet of gas gotten from the coal alone) from 12,432 (the product of a ton of coal and 10.99 gallons of oil), and dividing the remainder by said number of gallons, we see that each gallon of oil produced 132.48 cubic feet of 20.20 candle power gas, and, besides that, increased the illuminating power of 100 cubic feet (nearly) of 17 candle coal gas 3.20 candles.

We can arrive at a better understanding of what the oil did for us by converting the value of the gas into grains and pounds of sperm. Thus, the value of one cubic foot of the clear 1 gas was 408 grains, and that produced per ton 4,478,208 grains; while a cubic foot of gas from the mixture of coal and oil was 484.8 grains, or 6,027,033 grains per ton of coal and 10.99 gallons of oil. Now, deduct 4,478,208 grains (per ton of coal alone) and the remainder is the value (1,548,825 grains sperm) of 10.99 gallons of oil used in this case; or 20.13 pounds of sperm for each gallon of oil, which weighed only 6.12 pounds. So that we do much better, in terms of pounds at least, than the modern genius who invented a method of distilling and rectifying crude petroleum, and who claimed to be able to show one and one-half of one barrel of the finished product for each barrel of the crude oil that would be put through his apparatus. The representative of the genius, when asked how this was done, and where the matter which went into the formation of the other half barrel of product came from, explained that the thing was done by electricity, and that the substance came from the surrounding atmosphere, the oxygen of which entered into and formed new combinations with the oil in the apparatus.

This same process of distilling oil formed the basis of a still more wonderful invention, by means of which the best kind of illuminating gas was made for nothing. The amount that it was alleged could be produced from one barrel of crude petroleum was so great that the writer has forgotten the figures. The same process was much talked about recently, and there were men found who invested large sums of money in it, and who now are very bitter against inventors in general.

But let us return to our subject once more. If we reverse the rule, and convert the grains of sperm at which we valued the gallon of oil (according to our year's work) into cubic feet of gas of 20.20 candle power, we shall find that each gallon produced a result equal to 291.6 cubic feet of gas of that illuminating power. And by comparison in like manner we shall find, taking our figures, based on our work, that one gallon of the oil used was equal to 97.8 cubic feet of 60 candle gas; or 83.8 cubic feet of 70 candle gas; or 73.3 cubic feet of 80 candle gas. So that it appears that in our way of working we obtained all that has been frequently claimed for oil, but not more. Crude petroleum and the intermediate oil gave better results as to quantity, but had no useful effect on our naphthaline.

Thoughts and Notes on Water Gas Making.

By Frederic Egner.

In the previous article by the author it was said that the value of one gallon (231 cubic inches) of gas naphtha, of 63° Beaume, at 60° F., and weighing about 6 lbs. 2 oz., was equal to 20.13 lbs. of sperm, or 291.6 cubic feet of 20.20 candle gas. These figures were based ugon the average results of twelve months of gas making on a large scale. In computing the value of the oil, the coal used during the same period was credited with a yield far above the average, so that, if there was an error at all, it was in underrating the oil; and therefore it may be safely admitted that the value assigned to the oil is not a theoretical but a practical and entirely attainable quantity. Then why is it that in the ordinary methods of water gas making 4½ gallons of oil used, per 1,000 cubic feet of 18 to 20 candle gas made, is considered a good average result? If we convert the value of one cubic foot of 20 candle gas into grains sperm, we find it to be equal to 480 grains, and 1,000 cubic feet of the same gas equal to 480,000 grains. But one gallon of oil is equal to at least 140,910 grains, and 4½ gallons equal 634,095 grains of sperm. And yet 4½ gallons of oil have been used to (carburet) produce (with present methods) 1,000 cubic feet of gas, which is equal in value to only 480,000 of the same grains—a manifest loss of 154,095 grains of sperm in value of the oil now required for the production of each 1,000 cubic feet of 20 candle gas; nearly 25 per cent., if we do not count the gas obtained from the coal in the generator as anything. Well, the generator gas amounts to very little, so far as illuminating power is concerned, except, of course, to act as conveyance, heating agent, and diluent for the light-giving carbon atoms of carbureted water gas. Three and four-tenths gallons of gas naphtha and 45 lbs. of coal or coke should easily produce 1,000 cubic feet of 20 candle power water gas; and 4¾ gallons are sufficient for 28 candle gas. These quantities are to include the amount lost by ordinary leakage; in fact, comprise all the oil bought and used at any works for each 1,000 cubic feet of gas made.

It is not proposed to say much in this article about the fuel used in water gas making, only this: that although some years ago it was believed that only the very best of hard anthracite was suitable for water gas making, it has been found and claimed—notably by Mr. T. A. Bates, the able Supt. of the works of the City Gas Light Company, of Norfolk, Va. (unless the writer is greatly mistaken)—that gas coke gave the best results of all fuel used in the generator.

But the cause of the loss of oil, the principal factor in the cost of production of water gas, is the matter we wish to try and get at. Let us take, for instance, the apparatus illustrated on page 378, current volume of this Journal; and in order that the reader may have a more thorough understanding of the same, permit me to add a few words to the description of said apparatus, made necessary in this instance by reason of the "scale" accompanying the drawings not having been printed with the other illustrations at the time. The cupola was 18 feet outside, and 15 feet 9 inches inside diameter, and 26 feet high from the floor line to under side of outlet cross on top. As Mr. Geo. T. Thompson, who made the drawings from the original sketches, is a careful draughtsman, and the reproductions, although greatly reduced, are faithful copies of the drawings, the intelligent reader can construct for himself a scale by means of which all dimensions not given may be approximately obtained, if he will take the inside diameter of the outlet pipe in the hydraulic seal (Figure 1), and consider the same to be 24 inches.

We have here an apparatus which will do as well as any other to show the principal cause of the waste of oil pointed out. The lower portion is charged with solid fuel. This is brought to incandescence by means of an air blast. The gases so produced are burned in the upper portion of the cupola by admitting more air, and the checker brick or tiles are thus brought to a white heat. Then the air is shut off, steam and oil is turned on, and gas is made until the checker brick are cooled to such a degree that they will no longer serve to fix the oil employed in the operation. Then the steam and oil are shut off, and the lower portion of the cupola chilled again by an air blast to bring up the heat to the re-

quired degree. This cycle of operations is called "making a run." Now let us ask: *How can an apparatus, which is at a white heat at the beginning of a "run" and at a red hent at the end of it*, be expected to give back the full value of the oil which has been poured or squirted into it?

The above remarks apply, of course, only to the cupola, or to be more exact, to that class of water gas apparatus which employ a superheater or fixing vessel which is alternately heated and then used to fix the oil vapors. Whether the filling be checker brick, fireclay tubes, or incandescent coal, the action upon the oil remains the same. Much depends also upon the intelligence and skill of the gas maker. One-quarter—or even more—of a gallon per 1,000 cubic feet of gas made can easily be saved or wasted, according to the ability and care given to his work by the man who handles the valves and levers. A "good enough" man is not always the cheapest person to put in charge of a water gas apparatus, by many dollars per day.

The retort system of water gas generators, as distinguished from the cupola systems, would seem to get rid of the objectionable features of the latter very nicely. As for instance in the Allen and Harris process, where the oil is gasified in retorts at a nearly constant heat. But the water gas proper is not made at quite so good an advantage, and the results total are not any better than most of the cupola apparatus can show, so far as the writer—who has had some experience with both—has been able to learn. Theoretically, the process known as the "Equitable," or "Baby Process," ought to be the best; but practically there seems to be reason to doubt that it is. The doubt is as to its economy, not as to the quality of the gas made. The best results obtainable have been claimed for the Flannery Process, but no reliable data have been published. It seems that not one of the processes or apparatus named, or, for the very multitude of them, not named in this article, has yet produced illuminating gas in the manufacture of which the value of the oil as an enricher or carburetor has been brought up to anything like its real value, except it be the simple unpatented one for enriching coal gas, described in previous papers. Truly, there seems to be plenty of room for improvement in water gas apparatus, and if some thoughtful gas man, with time and money at his command, should seriously and studiously consider this matter of absolute waste of from three-quarters to one and one-quarter of a gallon of oil for each 1,000 cubic feet of water gas now made in the world, something might be devised that would greatly benefit all concerned in the business.

The Northwestern Colorado Coal Field.

By G. C. Hewett.

This portion of the State, being the northern half of its Pacific slope, is drained by four rivers, the Gunnison, Grand, White, and Yampa or Bear, which, with the Green, flowing south from Wyoming, unite to form the Colorado. These streams, fed by the snows of the Rocky Mountains, fall from an altitude of 10,000 to 12,000 feet at their sources, to 4,000 feet at the confluence of the Grand and Green in Utah, near the State line. This area, about 150 miles square, was the scene of great development in the periods subsequent to the carboniferous; but earlier formations have meager representation. The whole geological section is torn and contorted in every period up to the most recent by the movements that made the continental divide, and many outlying peaks and high plateaux. A single instance may serve to illustrate the extent of this action. The silurian limestones are lifted and partially eroded to form a plateau, fifty miles across, between the Grand and White Rivers, 3,000 to 5,000 feet above their level, and fifty miles west of the Range. The direction of all these rivers was determined by anticlinal cracks or fissures, since eroded to canons of 2,000 to 3,000 feet in depth. These streams and their tributaries show abundant evidence of glacial action, to which is largely due the extent of the arable land in upper benches and mesas. Until 1882 nearly all this area belonged to the Ute Indians. Hence the climate is not accurately known from systematic and continuous meteorological records; but it is probable that the rainfall at the same altitudes is 15 to 20 per cent. greater than on the eastern side of the Range, or, in other words, not far from 18 inches per annum. Since, however, much the greater part of this is in snow, the rivers remain at flood during July, and furnish water for irrigation, which the rapid descent of the streams makes inexpensive. The paucity of rainfall has allowed the accumulation of vegetable mould, and the gradual melting of the snow nourishes an abundance of natural grasses, which are cured by the dry summer and autumn. Where the carboniferous measures are exposed they have been crushed and twisted between the heavy limestones and quartzites below, and the enormous Jura-Trias above, and though they contain coal, it is extremely unlikely that any of it possesses commercial value. The Jura-Trias red sandstones are 3,000 to 5,000 feet thick, and their fractures have canoned all the streams of the Piedmont region at least once in their course. On top of these, separated by the Atlantasaurus shales, is the Dakota sandstone, a very prominent ledge, 50 to 100 feet thick.

In this sandstone is the horizon of a coal seam that may be of value, between the White and Yampa rivers and elsewhere. Above this ledge are 1,500 to 2,500 feet of Colorado shales, that, when upturned, are easily eroded, and have formed a chain of parks below the coal measure sandstones. The productive cretaceous coal-measures are 700 to 1,200 feet thick, and contain two, possibly three, series of coal seams. Above the coal, the softer sandstones and shales of the post-cretaceous, about 1,000 feet thick, have usually been eroded to gentle slopes. Over the larger part of the basin, the section is increased by at least 3,000 feet of tertiary measures, containing some petroleum shales that, when fresh, yield, on heating, considerable vapor. Since the region was outlined by the fractures that determined the courses of the rivers, many basaltic overflows have occurred; and, as these cap all the geologically and topographically high ground, it is probable that the whole basin was so covered. In the bed of the Eagle, above its junction with the Grand, is a lava flow so recent that, though the bed of the stream was changed by it, the edge is almost intact, and the adjoining partially vitrified shale has not been eroded. The coal-measures underlie most of this region in two great fields; one extending from the north side of the drainage basin of the Gunnison to the southern watershed of the Yampa, with the eastern and northern outcrops thrown up to 30 degrees to 90 degrees, and the southern flat; the other, a part of the Green river (Wyoming) field, extending into this State about forty miles on the upper Yampa river. As far as observed, these coal seams, where unchanged by flexure with consequent heat and pressure, carry a lignite containing from 5 to 20 per cent. of water; so that it is probable that the better coals will be found only on the narrow east and north margin, where the pitch averages 45 degrees. In the southeastern corner of the field, on the head waters of the Gunnison, the seams are horizontal, but, being in narrow and detached patches, have been locally metamorphosed, so that in four miles the same seams are anthracite, coking and dry coal. Going north from this point, anthracite is found in patches high on the sides of Mount Marcellina and the Ragged Mountains. The last peak of the latter, Chair Mountain, carries on its northern slope, from 9,000 feet altitude to 10,000 feet, a tongue of outcrop that is proved to be anthracite. Two seams only of the lower series are left from erosion, and but one is possibly of workable thickness. Five miles north, on the opposing pitch, the seams come up on Rock Creek as coking coal; from here the outcrop turns to the west around the topographical basin of Coal Creek, caused by the protrusion and erosion of the Colorado shales, the coal-measure sandstones dipping outwards in cliffs 1,000 feet to 2,000 feet high. In this basin the coals are extremely fat, and produce a hard, bright, sonorous coke.

Going north from this disturbance half a mile, the measures again dip to the west under the influence of the fold that made the anticlinal Valley of Rock Creek and Roaring Fork, and continue so for 23 miles northward to the Grand River, at an average pitch of 45°, and as a ridge a thousand feet higher than the parks of the Colorado shales to the east. This stretch of outcrop, intrinsically a most valuable part of the field, is cut by three streams that can be used by railway lines—viz., at six miles from the basin by one fork of Thompson Creek, one mile further by another, and six miles north by Four-Mile Creek. All these gaps have an altitude of about 8,000 feet, necessitating 8 or 10 miles of 4 per cent. grade to get up to them from the Roaring Fork Valley, with an altitude of about 6,000 feet. About opposite Glenwood Springs the measures come under the influence of the great uplift of the White River plateau to the north, around which they describe a wide circle for 69 miles, and standing at 50° to 90°, are known as the Great Hogback. In that distance the coal measures are accessible at eight gaps; but the conditions have nowhere been such as to produce a coking coal. Sixteen miles northeast of the White River gap, at Meeker, under the erosion of the Yampa Valley, the outcrop has lost the influence of the plateau, and is flat with a western direction for 32 miles. Here the influence of the Blue Mountain uplift is felt, and the outcrop is bent to the south for 12 miles, to the White River; thence it follows the foothills as a hogback to the State line, a distance of 34 miles in a westerly course with but two gaps. Near the State line and just south of this hogback on White River, at the mouth of Douglas Creek, there is an upheaval similar to that of Coal Basin, but of less violence, and without the conditions to change the character of the coal from dry to coking.

The geographically valuable parts of this 200 miles of outcrop are the

eastern and western, and most of the intrinsically valuable coal is in the southern 10 or 15 miles. The southern outcrop of this field begins on the head waters of the north fork of the Gunnison, a few miles west of Coal Basin, where the beds are flat and the erosion great; thence following that river, receding as it falls, it crosses the Grand 15 miles above their confluence, and takes its direction into Utah. In this field, as elsewhere in the State, the Halymenites sandstone is the only datum that approaches persistency. It varies from a compact, hard, white sandrock to a coarse, sandy shale, and over 30 miles of the southeastern outcrop the fossil bed on top of it is quite persistent. But it is not always the base of the coal measures. At one place, west of the Grand, there are two seams of workable size below it. In fact, all the measures of the section lack persistency; and beyond a liability of recurrence of two heavy sandstones inclosing the upper series of beds, a section in one gulch shows no resemblance to the next one a couple of miles away. There is no limestone in the measures, though many of the sandstones are impregnated with lime and gypsum. The 150 to 200 feet of sandstones and shales above the Halymenites sandstone always contain two and often three or four workable seams; and occasionally two or more come together and form a large and usually dirty seam. Thorough prospecting on 10 miles of outcrop, north of Thompson Creek, has shown that no seam remains workable in size a greater distance than 2 miles, and usually not half that distance. All the seams except one (and that worthless) are nearly as variable in character and marking as in size. These facts, with a cross-faulting every 4,000 to 6,000 feet of from 30 to 275 feet, make it difficult to say which of these beds are main seams and which splits. Whether the upper part of the measures should be divided is not certain. In many places there are two distinct horizons at which seams recur; but at three points of economical importance considerable prospecting disclosed but one, at 600 feet above the lower series. Development there shows that this series is more irregular and patchy than the lower series. It seems altogether probable that the break throwing up the outcrop occurred near the margin of the original field of deposition, because the size and number of the measures are greater where the erosion has been further from that line. All the seams are coking coal from Coal Basin north twelve miles, or about six miles either way from a point opposite to Sopris Peak, six miles distant, and the termination of the Elk Mountains, a spur of the main range. This peak attains an altitude of 12,800 feet. It is a gigantic outbreak, the center of four radiating anticlinal valleys; and the heat from it may have been directly or indirectly the cause of the coking quality of the coal seams, they are certainly most "fat" immediately opposite it and around the coal basin upheaval. Also the lower coals are the fatter.

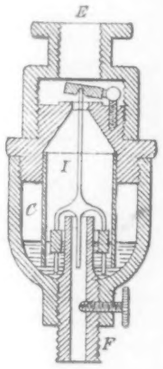
On the northern edge of this influence half a mile of development shows a gradual change from a good coking coal, with patches of dry coal, to a dry coal that with ordinary bee-hive treatment will barely agglutinate. In another half mile the same seam is dry. In this transition area, a small cross-fault makes the coal fat for twenty or more feet on either side.

The dry seams also present wide chemical and physical changes in short distances; a soft and loosely-bedded coal has in 100 feet become compact and hard without the intervention of a fault. A couple of hundred feet has reduced the water of combination from 12 to 5 per cent. In seams of coal free from binders of slate or bony coal, the squeezing during upheaval has obliterated the cleavage and often the bedding. The floor and roof of the seams are generally more or less shelly clay slate that slacks and crumbles on exposure. These facts, together with the pitch, make mining difficult; and extensive development will demand the modification of any systems now in use in the United States.

A New Gas Governor.

On February 13, 1889, English letters patent (No. 2,578) were issued to Messrs. T. A. Greene and C. M. Walker, of Cannon street, London, under which the inventors obtain protection for a gas governor. Their invention relates to the construction of a governor for regulating the supply of gaseous fluids, with an annular float situated in liquid subject to the pressure of the inflowing gas, which float has a central rising stem that butts against the under side of an inlet flap-valve so as to hold it in an open position without being connected thereto. In this way, any increase of pressure of the inflowing gas in depressing the level of the liquid, causes the float to descend, and the valve to close more or less by gravity.

In the illustration, the outer casing of the governor is shown closed at the top by a screw cap, to which is attached a cylindrical extension *C* passing down so as to leave a small opening between its lower end and the sides of the casing—thus dividing the space of the latter into a central or float chamber which communicates with the gas supply, and an annular outer chamber which communicates with the atmosphere. To the top of the cap is fixed a nozzle *E* by which the governor is connected to the gas supply pipe; and the central chamber communicates with this through a passage closed at top by a pivotted flap-valve. Into the lower end of the casing is fitted an outflow nozzle *F*, which projects up a certain distance into the float chamber, and the lower end of which is fixed to the outflow pipe. The casing is charged with mercury, introduced through an opening on the top, communicating with the outer chamber *C* of the governor, and fitted with a plug so as to leave only restricted communication between the outer chamber and the atmosphere; the central chamber being cut off from such communication by the liquid seal at the bottom. In the central chamber is placed an annular float of any suitable material surrounding the nozzle *F*, and having a central stem *L* connected thereto by a bridge piece. The lower end of the stem passes loosely into the opening of the nozzle *F*, which thus acts as a guide to it, while the upper pointed end butts against the apex of a conical recess on the under side of the valve so as to act as the upper guide to the stem. The quantity of liquid in the casing is so adjusted that the float will hold the valve open to a certain extent by means of its stem when the level of the liquid in the central chamber is slightly depressed by the normal pressure of the gas supply. On any increase of the pressure of the entering gas beyond the normal, this will depress the liquid level in the central chamber to a greater extent; causing the float to sink, and thereby allowing the valve to close to a corresponding extent, and consequently restricting the inflow of gas and diminishing its pressure, which action will be aided by the increased downward pressure of the gas upon the valve, and upon the float as explained.



Improved Method of Manufacturing Sulphate of Ammonia.

Some time ago M. de Lachomette made public a new process for the recovery of ammonia sulphate, which process, although fairly answering the desires of the inventor, has since been greatly improved on by him. In his current practice M. de Lachomette proposes to manufacture sulphate of ammonia from the ordinary gas liquors, by employing the sulphur originally contained in the coal as the source of his sulphuric acid. This sulphur is collected in the process of gas making, and it is therefore the spent oxide with which he has to deal. The ordinary process of converting sulphur into sulphuric acid by means of chambers appeared too complicated, and the inventor therefore proposes to avoid it by passing sulphur dioxide, obtained by roasting the spent oxide, and ammonia gas into water in the proper proportions for making ammonia sulphite, which is precipitated or crystallized, just in the same way as the sulphate. Some difficulty is found in maintaining the proper proportion of the two gases. If sulphurous acid be found in excess, bisulphite of ammonia, which is much more soluble than the sulphite, is formed. In this case the solutions are run into other tanks and there treated with ammonia until they have reached 34° to 36° B., after which treatment they deposit solid ammonia sulphite on crystallization. The mother liquors are again used for saturation.

The production of sulphite of ammonia is thus accomplished very easily and without inconvenience; it only remains to convert the sulphite into sulphate. The author has found that the absorption of oxygen takes place very readily if the salt has been previously deprived of half its water of crystallization. The reaction proceeds quietly when air is blown in, a considerable amount of heat being evolved. The amount of air admitted must be so regulated that the temperature rises to about 100°, but does not pass this point, so as to avoid the danger of decomposing the product. The author has also instituted experiments on the fertilizing value of ammonia sulphate, and has obtained results which are

quite as satisfactory as those given by the sulphate. He therefore hopes to be able in many cases to replace the manufacture of ammonia sulphate in the gas works by that of ammonia sulphite, and to apply this substance directly to agricultural purposes.

(Concluded from p. 597.)

Central Station Lighting.

By Prof. Geo. Forbes.

Insulation.—We have now to consider a very important, and perhaps the most difficult part of the problem of central station lighting—how are we to preserve our insulation? It must be noticed that we do not require a high insulation for the sake of getting a small loss of current; but only because with many insulators the high insulation is more permanent, and permanency is the quality of insulation which is most to be desired. I am not going to discuss at present the whole question of insulation, but rather to draw conclusions from the experience of the past. At the present moment vulcanized india rubber and okonite are the substances which have the highest reputation for durability and high insulation under all conditions. These, like other cables, are sometimes covered with lead, but in their case it is only as a mechanical protection, especially during the process of laying, because the destruction of the lead would not destroy the insulation. Of late years a class of cables has been much praised, about which I wish to speak. The copper conductor, stranded or otherwise, is covered with any fibrous material, preferably jute, impregnated with bituminous oils. This covered core is inclosed in the lead pipe. In this class of cable the insulation depends upon the lead being watertight. We all know of many places where this type of cable has done good work for a limited time, and many of us were inclined to believe that it was quite satisfactory; but I think I am right in saying that none of us know of its having worked successfully in any place for three or four years. I have said that a cable of this kind has hitherto been exclusively used in Berlin, the lead being covered with layers of tape or braid soaked in a preservative compound, and the whole armor-plated with two closed spirals of iron ribbon. I regret to have to tell you that this insulation has been a failure. It goes on well enough for about three years, then the lead gives way, the covering on the copper is permeated, and chemical or voltaic action sets up in the copper, which itself becomes disintegrated. So far as experience goes, this type of cable seems to me to be unsuitable for permanent work with the electric light. I trust that in the discussion we shall have some facts brought out. I had hoped, from what Berthoud and Borel, and also Waring, had done, that this would not be so, but the Berlin experience leads me to think otherwise; and on looking through the testimonials of makers I do not find that these cables, when placed under ground, have ever worked electric light circuits beyond the three years fixed by the Berlin people as being destructive. I have been told, but I cannot believe it, that there is one company in London actually proposing to put such lead-covered cables without covering into iron pipes. Of course, every one knows they would soon be eaten into by galvanic action.

At Berlin and elsewhere I believe there is the intention of trying some modification of the system of using bare conductors, first practically used by Mr. Crompton at South Kensington. Taking economy into account, it is probable that for low tension circuits this is an admirable plan. It is probable that it may also be adapted to high tension circuits by using oil insulators to support the bare conductors. When copper strip is used it is necessary to raise the cover of the trough in order to increase the number of conductors; this is very expensive. For my own part, I would prefer a drawing in system, if it were otherwise equally good.

At the present moment it seems to me that the only types of underground cable proved suitable for permanent work are either bare copper supported on insulators, or else vulcanized india rubber, or perhaps okonite. Especial care must be taken to avoid an insulator which is injured by the gases which permeate the soil of a town, or which has the property, like pitch, of becoming viscous, and so letting the copper become decentralized.

Meters.—The next lesson which the experience of foreign stations in Europe and America has taught us is the importance of charging the consumers of electricity by meter, like gas. I find that at present most companies in this country are charging the large proportion of their consumers by contract, making an annual charge for each lamp. This appears, from evidence collected everywhere, to be a fatal mistake. It is the universal experience that those stations pay best where meters are used. In many stations it is found to be the best plan to make a fixed annual charge, which may be put down as the rent of meter, and then an additional charge proportionate to the quantity of electric current supplied. This has the advantage of preventing customers putting in place a large number of lamps which during the greater portion of the year are idle, but which on festival occasions may all require current. Such idle lamps are very expensive to the suppliers, because a large reserve of machinery must be lying idle during the whole year to be ready for such occasions.

Within the last month I have described before the Society of Arts the different meters which are valuable, without pretending to estimate their relative value. For continuous currents we have the Edison and Aron meters, for alternating currents we have the Schallenberger meter, and for both classes my own "Windmill" meter.

Converters.—The induction apparatus used with alternating currents is called a "converter," "secondary generator," or "transformer." The reduction of pressure from the primary to the secondary circuit is generally 20 to 1, but sometimes more. A large number of types have been invented. I have elsewhere described the Westinghouse converter, which I have tested and found to be very efficient, even though the largest one he is in the habit of supplying is only for 40 lights.

Only the larger size of Zipernowski converter is so efficient. Three sizes are made, varying in efficiency from 95 down to 88 per cent., though the latter is a converter suitable for 25 lamps. Many of the types which are made in England I feel sure are far from efficient. There is a general opinion that the loss in the converter is necessarily small. This is by no means the case. A great deal of care must be taken in the design to get a satisfactory result. I think there is a general idea that any of the converters now on the market in England will give an efficiency for the average number of lamps in circuit of about 90 to 95 per cent. I should be much surprised if there are more than two types in use in this country which have an efficiency for the average number of lamps over 70 per cent. Yet, so far as I am aware, no maker in this country ever tests the efficiency of the converters which he supplies. The efficiency of a converter falls when it is underloaded. If the converter in a house is adapted for 100 lamps, and only three or four lamps are in use, then, with many converters, the current which is being used is double or treble what is required for the lamps. This defect in some converters is clearly shown in the load diagram of the Grosvenor Gallery installation, where during the hours of minimum supply the current sent out from the station is seen to be abnormally high—far above that of the load diagram of other central stations—and at the hours from 4 to 6 A.M. in October current sufficient for 4,000 lamps is indicated on the station meter. This curve shows a loss of 20 per cent. The type of converter which Westinghouse has perfected is one of low magnetic resistance. The worst ones now being made in England are of high magnetic resistance. The waste in a converter, independent of magnetic friction, varies as the square of magnetic resistance. The waste due to magnetic friction varies as the length of the magnetic circuit, if the induction in the iron is the same. These high magnetic resistance converters require a great deal of copper. The magnetic friction is so great that they would probably work better with an open magnetic circuit, as shown by Lord Rayleigh.

(Continued from page 596.)

Fireproof Floors.

To make this paper more complete, reference must be made briefly to other systems which have been introduced from time to time, and have met with varying success.

The "Fox and Barrett" floor, alluded to previously, consists of rolled joists placed about 20 in. apart. On the bottom flanges, strips of wood 1½ in. square were laid about ½ in. apart; concrete was then filled in between the joists, and the ceiling plastered, a key being afforded by the undersides of the fillets.

Messrs. Measures introduced and patented a modification of this floor, in which the joists were placed from 3 ft. to 4 ft. apart, and tee iron bearers 9 in. apart were substituted for the wooden fillets. The floor was then concreted on flat centering and ceiling plastered. This system was used extensively in London and elsewhere from 15 to 20 years ago.

Hornblower's floor consisted of a series of fireclay tubes resting in arch construction on larger tubes of the same material, filled with fine concrete, and strengthened with tension-rods secured to the walls.

Mr. Mark Fawcett has recently introduced a modification of the "Hornblower" floor, in which rolled joists are placed 2 ft. apart. Resting on the bottom flanges, and encasing them, semi-circular tubes of fireclay, 4½ in. diameter and 1 in. thick, called by the inventor "tubular lintels," are laid diagonally. The flat, or lower, surface has a projecting lip or flange, forming a wedge joint with the flange of the

next tube. The whole is concreted over with breeze concrete, and the ceiling plastered, the flat side being grooved in the same way as the bricks used by Messrs. Homan & Rodgers. (The cost, including joists, for a floor 12 ft. bearing, is 8s. 6d. per square yard, and the weight 40 lbs. per square foot.)

Allen's system consisted of a network of iron bars forming meshes 2 ft. square, covered with concrete. Iron bars 3 in. by 1 in., placed 2 ft. apart, were built into the walls; on these and wired to them, were laid ½ in. iron rods also 2 ft. apart. Flat centering was placed under this and concrete to a depth of 4 in. was laid on. The concrete was composed of four parts of crushed slag or clinker to one part of Portland cement.

Clark Bunnett's floor is of the flat floor and joist type, but wooden fillets are laid across the top flanges of the joists and clipped to them. Concrete is spread on flat centering and brought level with the top of the fillets; a layer of mastic is then run over the whole surface, which is finished off with wood blocks, or floor-boards nailed to the fillets through the mastic. The ceiling is plastered in the usual way.

Moreland's system, and that recommended by the late Sir William Fairbairn, may be taken together; as, in both cases, girders were used with arched iron plates carrying the concrete, the construction being that of a concrete arch with an iron lining to the soffit, and both, of course, were open to this great objection that a large surface of iron was directly exposed to the attacks of fire.

French systems: One of the earlier French floors was that known as "Thuasne's." It consisted of rolled joists placed 3 ft. apart. Resting on the lower flanges were laid flat iron bars or interties, the ends being secured by pins to straps passing over the joists. Iron bars ½ inch square, called "fautons," were laid 9 inches apart transversely on the interties and were wired to them; flat centering was placed under the joists, and a 3-inch layer of coarse plaster of paris was poured over the whole surface. A boarded floor was then laid on the girders.

Several modifications and improvements on this system have been made from time to time by French architects, and among them is one much in vogue now in Paris, in which the joists and interties are retained, the latter being placed 9 in. apart. Bricks on edge are laid on the interties and are then plastered on both sides. The Homan and Rodgers floor is an application of this system.

M. Zores exhibited a floor in the Paris Exhibition of 1857* on the arch and girder system, which has been much used in France. The girder consisted of wrought iron rolled in the form of an inverted flanged trough. These girders were placed 2 ft. 8 in. apart, and the arch was composed either of perforated bricks, or of hollow plaster blocks, in either case concreted above and plastered below. The American system has also been adopted in a modified form in Paris, moulded, perforated bricks taking the place of the terra-cotta blocks.

American systems: From papers on the subject read before the Royal Institute of British Architects by Mr. Gale in 1882 and Mr. Gass in 1886, the general system in America appears to consist of rolled joists and hollow arch-blocks of a hard-burnt clay resembling terra-cotta or fireclay, the joists being protected by skewback blocks with projecting lower members.

Another system consists of rolled joists and segmental hard-brick arches; the bricks used are 8 in. by 4 in. by 2½ in., and are of unusual hardness. The joists are protected by terra-cotta tiles fixed to the flanges by mortar.

In both these systems a thin layer of cinder concrete is spread over the arch, and the floor is laid on this. The system of arch-blocks and joists has been patented in England by Messrs. Doulton.

Pugging is also very largely used in America for fireproofing wooden floors. It consists of bricks laid flat on fillets between wood joists, and covered with a thin layer of cinder concrete. The joists are boarded over the top and the ceiling is formed with either terra-cotta or cement tiles, clipped to the joists by iron plates and well plastered at the joints.

Mention may be made of the so-called fireproof plasters and paints, which doubtless tend to retard the action of fire, owing to their being made of fire-resisting substances.

Robinson's plaster and the Hitchens Company's plaster are mainly composed of gypsum, and rely on its resistance to fire as opposed to the ordinary lime plasters; in the Hitchens plaster slag wool is used in addition.

The Cyanite Company have produced a paint the principal ingredient of which is silica, a material which has long been known for its great powers of resistance to fire. This paint is no doubt a great protection to exposed timber.

Asbestos is another material which can be used either in the form of plaster or paint, but its properties are more of a non-conducting nature than fire-resisting.

Slag wool and slag cement, now both in their infancy, are also coming into use in fire-resisting construction. There is little doubt that slag cement, which is rapidly supplanting Portland cement in Germany, will shortly be largely used for concrete floors in this country. It is both cheaper and lighter than Portland cement, and when mixed with sand is considerably stronger, while its fire-resisting properties exceed those of both gypsum and Portland cement.

Taking the relative merits and defects of the different floors into consideration, it will perhaps be better to deal with the individual floors first, and then to contrast the types of construction.

Comparing the arched systems, in both the Dennett and Wilkinson floors, brick forms the basis of the concrete, one depending on gypsum and the other on Portland cement. Of the two, gypsum gives more resistance to fire, and is the lighter; but, its cohesive power being less, the concrete has to be made in stronger proportion. Hence the increased cost.

In both systems the weak point appears to be the want of protection to the joist, which is dependent on a plaster covering. The Doulton floor overcomes this feature in a way as effectual as any, and this is a very strong point in its favor. Its disadvantages are that it requires a layer of concrete or dry filling over the top to make it air and water tight, thus forming two layers of different material, one of which is more affected by heat than the other; that it cannot be used in such wide spans as either of the others without increasing the depth, and consequently the cost; and that there is a considerable amount of thrust. The lightness is much in its favor, but the extra concrete or filling, and the greater number of joists required, must be borne in mind when comparing it with the others. Of the three, the Dennett floor has undoubtedly popular opinion in its favor; but apparently a good fire-resisting floor of arch construction could be made by a combination of the Dennet and Doulton floors, the joists being protected by the Doulton terra-cotta blocks covering the flanges, and acting as springers to an arch of Dennett concrete.

The three flat floors again differ mainly in concrete. The use of trussed rods in Lindsay's doubtless strengthens both joists and concrete, but at the expense of an increase of metal, thereby giving an additional chance to fire. The nature of the flat construction is a series of suspended landings or slabs, supported by joists and completely encasing them, thus forming a homogeneous mass which acts as a dead weight on the walls or supports, dispensing entirely with thrust, and serving to tie in the walls.

The three are identical in cost and safe load, the difference in weight being in favor of Dawnay's, and for resistance to fire, preference must also be given to Dawnay's, the concrete of which is composed entirely of broken brick and Portland cement, the former giving more resistance than coke breeze, on which both Lindsay's and Gardner's depend.

The Homan & Rodgers floor is of the flat construction, bricks supported by iron bearers taking the place of the solid concrete slab. This floor is considerably lighter than any one of the other three, and not much more expensive; but the additional metal of the tee-irons is certainly against it, as, although protected by plaster, directly the iron goes the bricks follow, while the tee-irons would also give a vibratory effect to the floor when used for moving loads. Another defect is that, when constructed, this floor is in layers of materials differently affected by heat. Its lightness and shallowness are, however, both in its favor.

Coming lastly to Evans & Swain's floor, the chief disadvantage is the cost; but for strength and lightness it is inferior to none. It can be used in as wide spans as any of the others without intermediate supports, is more homogeneous, and requires less strength in the walls than the concrete and iron floors. A grave disadvantage is the liability to dry-rot, as the floor, being a solid mass of timber, if dry-rot once obtained a hold it would be next to impossible to prevent it from spreading without frequently removing the floor and ceiling for inspection, and thereby creating a kind of charge for maintenance which is not required in any of the other systems; but as a fire-resisting medium the density of this floor, coupled with the absence of iron, renders it as effective as any of the others.

Contrasting the arched and flat floors, it is obvious that the use of the flat floor involves more joists, as the concrete slabs, being virtually beams supported at both ends, cannot be used in such wide spans as the arch, the joists in the latter being from 7 ft. to 10 ft. apart, while in the former the average is from 18 in. to 3 ft., thus involving the use of more iron; but, on the other hand, the concrete casing of the flat floor is a better protection than the plaster covering of the joists in the arched floor.

* See Rivington, part II., p. 377; date given 1857

The action of the arches pressing against each other no doubt tends to brace and strengthen the joists laterally; but against this is the thrust on the outer walls and the increased weight of the joists, which have to carry a much greater load than in the flat floors, and consequently add to the weight on the walls or supports. The head room required for the arch is also a serious consideration when opposed to the shallow depth of the flat floors.

In the matters of cost and weight, the advantage certainly lies with the flat floors; while for safe load, with the exception of Evans & Swain's, which is lighter and stronger than any, there is nothing to choose between either arched or flat construction, the strength depending on the joists used.

In summing up between the different floors there appear to be two leading features for consideration:

Firstly.—Which system gives most protection to the iron work supporting the floor?

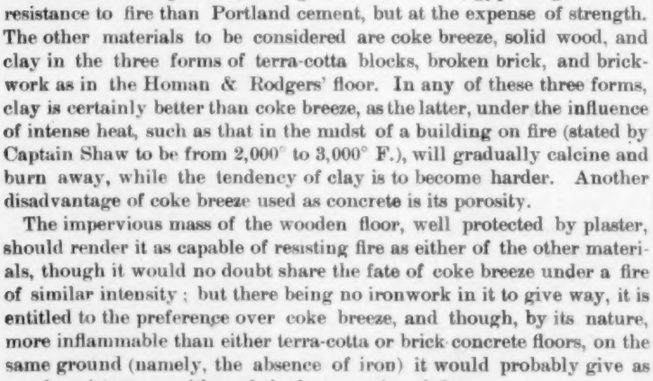
Secondly.—Which of the different materials employed gives most resistance to fire?

Looking at the first question, Evans & Swain's floor, requiring no iron work, stands by itself; but next to it, and certainly in advance of all the others, on this one point, must be placed Doulton's floor, the hard-burnt blocks, with their overlapping bases, forming a most efficient protection to the joist. There is little to choose between the different concrete floors on this point, as in the case of the arched floors, there are comparatively few joists dependent on a plaster covering; while in the case of the flat floors, there are from four to six times the number of joists, which are, however, completely imbedded in concrete. The Homan & Rodgers' floor has more iron work than any of the others, both joists and tee-irons depending entirely on a plaster ceiling.

On the second question, taking the cements first, gypsum gives more resistance to fire than Portland cement, but at the expense of strength. The other materials to be considered are coke breeze, solid wood, and clay in the three forms of terra-cotta blocks, broken brick, and brickwork as in the Homan & Rodgers' floor. In any of these three forms, clay is certainly better than coke breeze, as the latter, under the influence of intense heat, such as that in the midst of a building on fire (stated by Captain Shaw to be from 2,000° to 3,000° F.), will gradually calcine and burn away, while the tendency of clay is to become harder. Another disadvantage of coke breeze used as concrete is its porosity.

The impervious mass of the wooden floor, well protected by plaster, should render it as capable of resisting fire as either of the other materials, though it would no doubt share the fate of coke breeze under a fire of similar intensity; but there being no ironwork in it to give way, it is entitled to the preference over coke breeze, and though, by its nature, more inflammable than either terra-cotta or brick-concrete floors, on the same ground (namely, the absence of iron) it would probably give as much resistance as either of the last-mentioned floors.

Mr. William Lindsay, Jr., has recently designed and patented a fireproof floor, which, although it has not yet been used, apparently fulfils the two requirements laid down by the author, and therefore deserves recognition in this paper, while the cost and weight compare favorably with the systems already described.



Mr. W. Lindsay's Fireproof Floor.

The floor is of the flat brick type, and consists of steel joists, placed 2 ft. apart, with rectangular hollow bricks suspended to them by means of a jaw or recess at each end. The bricks are 2 ft. long, 4 in. wide, and 4½ in. deep, with a central horizontal web running from end to end, the thickness of the sides and web being ½ in. The bricks are moulded with longitudinal dovetailed grooves on both surfaces to afford the necessary key for plaster and concrete, while a bond is obtained by means of a wedge-shaped boss or projection running the full length of the brick, fitting into a corresponding recess on the next brick and forming a joggle as shown in the accompanying diagram. The lower flange of the joist is protected by a narrow tile resting on the jaw of the brick, while the upper flange is covered with a rectangular channel pipe made of the same clay as the bricks, and bedded in the concrete covering. The under side is then plastered, while the floor can be finished as required.

The clay of which the bricks are made is of even texture and unusual hardness when burnt; in fact, it closely resembles the hard-tile pottery of the Roman period. When tested recently, the mean breaking weight at center on a bearing of 20 in. exceeded 15 cwt. per brick. This would give a safe distributed load of nearly 6 cwt. per square foot.

The objection, stated previously, to floors consisting of two layers of different materials is overcome in this case by using concrete composed of the same burnt clay as the bricks; thus, although in two layers, the materials of each are identical.

The cost of this floor is 6s. 9d. per square yard, and the weight 29½ lb. per square foot, including joists and concrete.

If it were possible to expose all the floors described, together with a brick arch, simultaneously to a fire burning for several hours at a temperature of 2,500° Fahrenheit, the author is of opinion that the only floor which would be found "fireproof" would be the brick arch, although the others are undoubtedly capable of giving great resistance to fire, retarding its action by confinement, and in this way giving greater chances of extinction.

The conclusion arrived at finally is that, with the exception of the brick arch, there is no such thing as a "fireproof" floor, and that it would be more correct to describe all these floors as "fire-resisting."

The following works have been consulted in compiling this paper:

"Proceedings of the Inst. C.E."

"Proceedings of the R.I.B.A."

Rivington's "Building Construction."

Captain Shaw's "Fire Surveys."

The author desires to express his sincere thanks to the makers of the different floors for the kind way in which they have all assisted him with the fullest information and illustrations of their respective systems.

Direct Production of Hot Air from Cold.

The London *Times* says that a discovery having an important bearing in the present upon the arts and manufactures has recently been made by Mr. Wm. Gibbs, of Essex. The discovery is to the effect that perfectly pure air can be produced from the combustion of coal. The arrangement for effecting this result is extremely simple. It consists of a brick chamber, about 5 feet long by 2 feet wide and 2 feet high, built upon the ground. At one end is a lead chamber and a fuel chamber, and at the other a powerful exhaust and blast fan. Placed immediately between the chamber and the fan are baffle-plates, a standing ridge with perforations at the back, and a hanging ridge with perforations at the front. There are also several carefully-proportioned inlets to supply the exact quantity of air requisite for perfect combustion. The exact apportionment of the air constitutes one of the main points of success, and it is the one which Mr. Gibbs found the most difficult to determine. Once known, however, this law of proportion between air and fire is, of course, easily maintained.

Another point having a very important bearing on the result is the exact relative proportion of the fuel chamber to the feed chamber, and both to the volume of air drawn per minute by the fan. This also being ascertained, after many failures, is now a fixed instead of a doubtful quantity. Given these proportions, and some other of minor importance, the result is distinctly curious.

Issuing from a fan mouth 12 inches in diameter comes rushing a column of hot air, marking on the pyrometer at its exit a steady, uniform temperature of about 500° F. Not a trace of smoke or fume is visible to the naked eye; not a taint of any kind is perceptible to the taste or smell. Standing as we did on the range of this simoon, with the hot blast full in the face, the heat is, of course, excessive, but the air is perfectly pure. Save in the matter of temperature, it affects neither the eyes, the throat nor the nostrils. As a proof of this purity, some choice tea which had been saturated with hot water was placed in the hot air current, and when redried was pronounced by an expert to be wholly free from any imparted taint or taste.

In order to show the character of the products of combustion before being submitted to the fiery ordeal, the fan was stopped, and a dense cloud of thick smoke rose up from the coal in the feed chamber, charged with suffocating fumes. On restarting the fan it was quickly drawn in again, and not a sign of it appeared at the exit from the fan, and the air

when inhaled was as pure as ever. It would be interesting to know the rationale of the process by means of which all the varied products from coal combustion are thus so completely destroyed. Mr. Gibbs suggests that the water contained in the coal is decomposed into oxygen and hydrogen, and that the hydrogen in burning adds to the heat of the result ant air, while the oxygen, reinforced as it is by that obtained from the large volume of fresh air admitted at the various inlets, decomposes and purifies all these products. But whatever the theory may be, the fact remains that it is not only possible but easy and economical to obtain the utmost amount of heat from coal without deterioration of the atmosphere.

The success attained by Dr. Gibbs naturally suggests the application of the principle in many other very important directions in connection with the industrial and mechanical arts as well as for steam-raising purposes and for domestic use by the suppression of open fires in stoves.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE authorities of Glens Falls, N. Y., have awarded a contract for the public street lighting to the Glens Falls Electric Light and Power Company. Under the agreement 55 arcs are to be maintained, on 25 nights in each month, the rate to be 28 cents per arc per night. The contract is to last one year from June 1st.

MR. CHARLES B. HURLEY, son of Wm. H. Hurley, of Philadelphia, has been appointed General Manager of the Tacoma (Washington) Water Gas and Electric Light Company.

J. J. GALBRAITH, City Clerk, Williamsport, Pa., asks for proposals "for thoroughly lighting the city for a period not to exceed five years, by electric light, gas, or any other means." The lights are to burn from dark to daylight each and every night in the year, and the bids are to be made on a specified price per night, or for an annual total sum. The competition is to close at noon of Wednesday next.

WE understand that the sale of the property and franchise of the Dorchester (Mass.) Gas Light Company to the Bay State Company has been practically consummated. The reported price is $125 per share, and at that figure the purchasers undoubtedly have the better end of the trade.

In the meantime the original shareholders are entitled to the dividend of $2 per share recently declared.

THE electric lighting annex to the Woonsocket (R. I.) Gas Company's plant is well underway.

THE chance is that Dalton (Ga.) is to have another Gas Company that will be owned and operated exclusively by local capitalists. Those interested are Dr. R. I. Peek, G. W. Oglesby and S. E. Berry.

CALVIN INGRAHAM, an employee of the Equitable (Chicago) Gas Company, sustained a concussion of the spine because of falling through an elevator shaft at the Archer avenue works. His injuries finally resulted in death.

THE subway explosions in this city caused the authorities of Washington, D. C., to inquire into the likelihood of a similar happening there. The matter was turned over to Prof. Richardson, the District Chemist, who, as the result of a careful investigation, handed in the following report: "I have made an examination of the electrical subways in this city for the purpose of detecting the presence of coal gas in them, and have the honor to make the following report on the subject. The loss of gas by leakage in our streets is stated by the President of the Washington Gas Company to be but 4 per cent. of the amount passing into the mains. It is, therefore, improbable that large leaks should afford a means of supplying sufficient gas to form explosive mixtures in the subways. In fact, after careful examination, only four manholes have been found where the odor of gas could be detected, namely, at Pennsylvania avenue and Second street; at Pennsylvania avenue and Eighth street, and at the fourth manhole in front of the Executive Mansion. In none of these was the amount sufficient to make the atmosphere of the hole explosive, and even were it so the small space, but a few cubic feet, would not contain sufficient gas to cause a dangerous explosion if ignited, and would probably do no more than lift the cover. I am of the opinion, therefore, that there exist no conditions at present for explosion in our electric subways, but shall continue my investigations more in detail in the near future."

IN connection with our prior intimation that the Columbus (Ga.) Gas Company was about to construct an additional holder, we print the following, from a correspondent at that point: "The Company proposes, as you said, to build a new holder with a capacity of 75,000 cubic feet, and the vessel will be constructed on the most approved modern lines. A purifying house (34 ft. by 48 ft.) has been planned to hold four large boxes, and this division will also be equipped in accordance with the latest practice. Other additions and betterments will be made, which, when completed will place the Company in position to meet any and every demand. There is little doubt but that a reduction in selling rates will be made as soon as the betterments are completed, and in connection with Columbus gas rates it might be well to note, as an evidence of the progress made in this direction during the last 25 years, that gas sold here at $10 per thousand in 1865. In 1879 the price was cut to $5, and in the last ten years successive cuts have brought us to $2 per thousand. In fact it is an open secret that Messrs. Jenkins and Blanchard will not rest satisfied until the dollar notch is cut. Preliminary work on the improvements above outlined is pretty well advanced, the contracts for machinery, etc., have all been awarded, and Supt. Jenkins expects that everything will be completed before September 1st.

DURING the month of April the dividend amounts declared on gas shares largely held in San Francisco footed up in the sum of $63,500. The details are appended:

Name of Company.	Rate per Share.	Amount.
Capital Gas	$1.00	$10,000
Oakland	.20	6,000
Pacific Lighting	.30	3,000
Pac. Gas Imp	.40	12,000
S. Diego Gas and Elec	.25	1,250
San Francisco	.30	30,000
Stockton	.25	1,250

The total amount disbursed in the corresponding month of 1888 was, if memory may be trusted, $52,570.

ANOTHER interesting item in connection with dividend disbursements on account of the earnings of San Francisco artificial lighting companies, is that the California Electric Light Company is not at present returning anything to its shareholders. This Company has paid several dividends, but its failure to continue the practice has caused the stock to decline to $16 per share; and local investors consider it yet too high.

THE Chicago City Fathers less than a fortnight ago received a report from the Committee on Gas to the effect that the Comptroller be instructed to contract with the gas companies for a supply of gas to the public buildings, on the basis of last year's rate—$1 per thousand cubic feet. Having discussed the proposition at great length, an amendment was carried which provided that the report be not ratified, and that the contract be not made unless the gas companies agree to furnish gas to private consumers at the rate that was to be charged the city.

AT a meeting of the projectors of the Grand Rapids (Mich.) Fuel Gas Company the following officers were chosen: Directors, Adolph Leitelt, O. A. Ball, W. D. Talford, John Steketee, Fred. S. Clark and F. H. Ball; President, Adolph Leitelt; Secretary, F. H. Ball, Treasurer, W. D. Talford.

THE gas war at Fort Scott, Kansas, having been all but terminated by an agreement between the contestants, from which it seems that the St. Louis interest is to remain in the ascendant, the question now is as to what valuation shall be put on the property of the sellers. To determine this appraisers are to be selected, and as Mr. Ed. J. King, of Jacksonville, Ill., has consented to serve on the board, both sellers and buyers are to be congratulated. As far as he can go in the matter—and it may be taken for granted that he would not have accepted the call without a clear understanding that his voice would be a potent one in the councils of the estimators—each party to the bargain can depend on his absolute fairness.

THE Massachusetts Gas Commissioners have again postponed the hearing of the appeal of the Walworth (Boston) Light and Power Company from the order of the Boston Aldermen, which negatived the Company's right to carry on business in that city. The date for the hearing has been put at May 25.

THE Jackson (Miss.) Electric Light Company is putting in an incandescent service, with the hope that this move will induce the local gas

men to buy out their electric competitors. Vain hope, however, if what we hear from that point about the standing of the electric company is correct.

THE Twin City Gas Company, which supplies the towns of La Salle and Peru, Ills., with gas, is enjoying quite a boom in business; and Manager Duncan, in common with his associates, enjoys himself thoroughly when looking over the credit footings to "Profit and Loss Account." Long may he and they experience that serenity which comes with a comfortable balance at the bankers.

THE New York and Philadelphia divisions of the Welsbach Incandescent Gas Light Company are being wound up. Under the conditions of the stock subscription lists, shareholders are being paid back their investment less the amounts expended for running expenses since the shares were paid for. In the Philadelphia instance this drawback amounts to $1.53 per share, while the New York drawback figures at $2.

THE following, from the St. Louis *Post Dispatch*, 4th inst., explains itself: "The options on both the Laclede stock and the Gas Trust certificates will expire on Monday next (6th), and to-day is the latest date at which the purchasers of the Laclede would be obliged to take such stock as was offered. The option was to expire on May 5, according to the original terms of the agreement. This date falls on Sunday, and many of the stockholders were uncertain as to whether the contract was to be closed. A call was made upon President John P. Keiser to obtain a solution of the problem. The question elicited a laugh from the good-natured President. 'I saw the mention made of the peculiar date selected in the *Post-Dispatch*,' said Captain Keiser, 'and we must plead guilty. We certainly did not intend any disrespect to the Sabbath, but simply failed to watch the calendar closely enough. The option will not expire until Monday. You can state that officially.' 'Has all the stock been signed?' 'More than enough to insure the the sale of all that is offered.' 'Will anything be done to-day?' 'Nothing has been done as yet; but we may have further news from the East this evening.' The option on the Gas Trust certificates does not expire until Monday, but it was learned at the office that far more than the necessary majority to consummate the sale had been secured. About 20,000 shares held in the East had been signed, and over 30,000 shares held by St. Louis investors. Thus more than 50,000 of the 60,000 shares had expressed willingness to come in at the terms proposed, while a majority of that held by non-signers did not represent opposition to the proposed transfer, but for one reason or another had not been represented. As to the proportion between those who would take preferred stock and bonds and those who preferred cash payment, the exact figures were not obtainable; but it was learned that nearly all preferred remaining stockholders, and that in proportion to the magnitude of the transactions the amount of money changing hands will be very small. The stockholders of the Laclede have the option of receiving $140 a share in cash or bonds bearing interest at the rate of 5 per cent. equal to the amount of their stock, and 25 per cent. of this amount in preferred stock. Five per cent. interest must be paid on this stock, if the Company earns it, and this is cumulative. That is to say, if 5 per cent. is not earned in one year, and 10 per cent. is earned the next, all this must go to the holders of the preferred stock before the owners of the common stock receive anything. The agreement with the holders of Gas Trust certificates is the same, with the exception that only $87.50 will be paid for each certificate. President W. H. Thompson says that the sale is, and has long been, an accomplished fact. The holders of shares in the St. Louis and Carondelet Gas Light Companies, who never came into the Trust agreement, have almost without exception agreed to the terms proposed, and the deal will without doubt be closed on Monday. The money due those who prefer cash will either be paid at the Bank of Commerce or in New York. The certificate holders of the Gas Trust, while the majority of them have appended their signatures to the agreement of sale, are anxiously awaiting the arrival of Socrates Newman, who so far has not shown his hand in the transaction. He has for several days been absent from the city, and not a few stockholders, who had been in vain looking for his signature, are still holding off to discover whether or not he will enter into the agreement. A number of calls were made this morning at the office of the Gas Trust, and also at the Bank of Commerce, for the purpose of ascertaining what the opinion of President W. H. Thompson was on the subject. Mr. Thompson, however, was not to be seen, and it was learned that he was absent from the city, presumably in New York. Shortly after the opening of banking hours this morning a deposit of $500,000 was received at the Boatmen's Bank, for the purpose of meeting any claims that might be made by the stockholders, although the best legal opinion is said to be to the effect that no money need be put up until Monday. This news, which was freely circulated on the street, caused not a little discussion to take place, and the opinion was often given expression to that this premature movement was intended to operate as an inducement to the present stockholders to accept bonds and preferred stock instead of cash in return for their holdings. To meet all the Laclede stock, for which $140 a share is offered, the Company being capitalized in $2,500,000, the sum of $3,500,000 would be necessary. The fact that a deposit of $500,000 is deemed sufficient to meet all the demands made is regarded as significant of an agreement between the St. Louis stockholders and the purchasing syndicate.

THE Washington (D. C.) Electric Lighting Company has been ordered by the District Commissioners to pay the sum of $3,379.74 to Contractor H. L. Cranford, in full settlement of his claim for work done by him in relaying the pavements over the Company's subway. The Company held that Cranford should have obtained this sum from the District Commissioners.

IN completion of our item to the effect that the Dorchester (Mass.) Gas Company had passed by purchase under the control of the Bay State Company, the following is given. The entire c pital stock consists of 4,000 shares (par value, $100), and of that amount the Bay State purchased 3,700 shares at the rate of $125 per share, which figure is about 9 points over the last prior recorded sale and transfer. The shareholders who have not yet assented to the arrangement may take advantage of the same at any time within the 90 days terminating August 1st, next. Within a few days the present executive management will retire, and the active interest will designate their successors. There is every likelihood that, owing to the proximity of the Dorchester works to the Commercial Point station of the Boston Gas Light Company, the former will be speedily shut down, so that the district may be supplied from the mains of the latter. It has been decided on that Mr. F. P. Addicks will be named as Treasurer of the Dorchester Company, the organization of which as a Company will undoubtedly be maintained.

PRESIDENT JUDSON, of the Consumers Company, of Chicago, has notified the first mortgage bondholders of the Company that a special meeting is to be held at noon of the 25th inst., for the purpose of filling the vacancy "in the office of Trustee, under the deed of Trust made by said Company to secure said bonds, occasioned by the resignation of Mr. John J. P. Odell, the present Trustee."

THE Street Lighting Committee of Pittsfield, Mass., has awarded a contract for the public lighting to the local electric company. The plan is to maintain 50 high candle power arcs, and probably 200 incandescents (16-candle power each) in place of the gasoline lamps now in use in the outskirts of the town. These lights will be extinguished at 12:30 A.M., as will also the arcs. The gas lamps in the central part of the town will be lighted at midnight and extinguished at daylight, the police to have charge of the lighting and extinguishing.

THE Indianapolis (Ind.) Economy and Light Company has been incorporated by Messrs. Isaac Van Sickle, W. Strong, Chas. H. Marshall, C. C. Cartsau and W. F. Robb. It is capitalized in $100,000, and the avowed object is "to furnish gas illuminants and gas enrichers."

PRESIDENT POWELL, of the village of Waterford, N. Y., has entered into a contract with the Citizens Gas Light Company, of Troy, under which the latter agrees to supply gas to the public lamps and local engine house at the rate of $2 per thousand cubic feet.

"NEW YORK, May 9th, 1889.—Dear Mr. Editor: One of the greatest boasts, and one that contains much more of truth than any other put forward by them, made by the electricians, is that street illumination by gas has had its day. While admitting that the blinking arc has done and is doing (even though at rather high cost) much effective work on the thoroughfares of the country, gas men have not conceded that their inning was ended. Inventors have long been busy in well-directed attempts to bring out a high candle power gas burner for street lighting purposes, and while but indifferent success has attended past effort in this direction, I think it will be matter for congratulation to the fraternity to know that in this city at the present time may be witnessed nightly an exposition of street lighting by gas that is at once wonderfully effective and quite economical. I refer to the lighting of that portion of Madison avenue lying between 31st and 33d streets, as carried out under the

auspices of the Siemens-Lungren Company, whose proprietors are prepared to demonstrate the virtues of the improved Gordon regenerative type of street gas lamp. The lamps now lighting the district noted are distributed as follows: One each on the diagonally opposite corners of Madison avenue, 31st, 32d and 33d streets, one between 31st and 32d streets, and one midway of the block bounded by 32d and 33d streets. The writer, who heard that the illumination of the district was most successful, but who also thought that his informant had an eye single for gas, journeyed to Madison avenue to see it for himself. Having seen it he is convinced that the Gordon can be trusted to give electricity a battle for public favor in street lighting, wherever gas is sold for less than $1.50 per 1,000. My surprise over the beauty of the illumination was complete, and as a spectacle alone it is well worth the tribute of a visit. The avenue blocks were enveloped in a flood of mellow light, the brilliancy, clearness and steadiness of which could not be exceeded. No portion of the avenue pavement and footwalk, at a point one-half a square (100 feet) from the end lights and between the supporting factors, could be chosen where one could not read a finely-printed book or newspaper with perfect ease and without experiencing the slightest strain on the eyes. Unlike the Lungren lamp, the flame from which issues from a circular ring of jets at the center, and then coils around and up externally—and the Lungren, all will admit, is a most admirable lamp for interior application—the Gordon flame comes from an exterior ring to turn up beneath it, and in a graceful and steady stream of light disappears through the center of the circular burner. The Gordon accomplishes successfully what the Lungren but partially succeeded in effecting—the furnishing of a perfectly continuous and regular light for outdoor purposes. It has the further advantage of being easily cared for, and will last for years. Those in the Madison avenue district are rated to consume 15 cubic feet per hour, and any unprejudiced observer will at once concede the modesty of Mr. Gordon's 300-candle power claim for the duty obtained from each specimen—certainly this will be conceded if his lamps are measured by the 2,000-candle power effect said to be yielded by the electric arc located on the block bounded by Fourth avenue and 32d street. I am ready to stand by it that if Mr. Millis will measure the Gordon lamp, and then 'try' its arc competitor before noted, the Gordon will have the verdict. I believe that the Gordon type of street lamp will in time be as popular for external lighting as the Lungren and Wenham now are for internal illumination.—B."

THE Athens (O.) Gas Light Company has petitioned for the right to enlarge its powers, and to change its corporate title to that of the Athens Gas and Electric Light Company.

AT a recent meeting of the Gas Committee, Allegheny (Pa.) Councils, a resolution dealing with the electric lighting of the parks was read. The presentment was to the effect that as electric lighting was costing $2,000 a year in excess of what gas had cost, it was bounden on the Committee to secure a reduction, or else to return to the use of gas.

CLEVELAND, O., seems to be such a fruitful field for the pursuit of profit that the water gas speculators hate to leave the last stone unturned. It was presumed that the last defeat was final and conclusive; but it seems not, for towards the close of last month a resuscitation before the Council Chamber was witnessed in the presentation of an appeal for the passage of an ordinance vitalizing the "Cleveland Fuel, Power and Lighting Company." It is the same old chestnut, and is likely to meet the fate that was meted out to its predecessors.

THE streets of Winchester, Va., were lighted up with electricity, for the first time, on the evening of May 4. The contractor is the Winchester Gas and Electric Light Company, which, as previously noted in the JOURNAL, was installing a plant of the Schuyler type. The turning on of the current was made the occasion of a dress parade by the fire department and the local militia.

MR. TOPP, of the Board of Public Affairs, Cincinnati, Ohio, having arrived at the conclusion that the practice of the Gas Company in respect to the measurement of the gas supplied to the public lamps was faulty, proposes that a friendly suit be brought to have the plan in vogue set aside.

A HINT from North Adams, Mass., to the effect that since the electric light plant in the Hoosac tunnel was completed considerable trouble has been experienced with the conductors. The lights are far from giving that satisfaction which the needs of the location demand.

THE situation in Brooklyn is said to be far from smooth, although surface indications are to the effect that peace and prosperity abound. The Citizens and Metropolitan Companies are badly handicapped in the matter of inadequate distribution systems, and the shareholders seemingly fail to understand why the conditions of a decade ago are not those that still maintain. It is a pity that the last-named Company is not under a more active management. Were some life infused into it, and the paring-knife relegated to obscurity, then it might reap some material advantage from the magnificent growth of its territory.

IF the St. Louis deal is completed, it is not at all definitely agreed upon that the Carondelet works will be shut down. The water gas plant, however, is sure to go.

IT is now about settled that the City Council of Macon, Ga., will authorize the Edison Company to perform the public lighting on the expiration of the present contracts, which run to July 1st.

THE following from the annual report of the Massachusetts Board of Gas Commissioners will be of interest to those engaged in gas manufacture. It has been the case almost invariably that where the price of gas has been reduced the increase in the sendout has fully recouped the reduction made.

A comparison of the three companies in Cambridge, Lowell, and Worcester, for a period of ten years, shows that the increase in the output of gas is governed to some extent by the reduction in price. These cities have nearly the same population, and the ratio of growth has been nearly the same in each during the past ten years.

	Cambridge.		Lowell.		Worcester.	
Year.	Gas Sold.	Price.	Gas Sold.	Price.	Gas Sold.	Price.
1878....	59,131,911	$3.00	80,471,400	$2.00	42,935,000	$2.85
1879....	57,642,161	3.00	87,676,700	2.00	41,478,400	2.85
1880....	57,399,173	2.75	99,559,300	1.80	45,778,400	2.25
1881....	60,544,850	2.75	110,508,300	1.65	54,676,900	2.25
1882....	64,632,653	2.50	119,695,000	1.65	61,693,200	2.25
1883....	69,518,500	2.25	135,563,200	1.60	67,746,200	2.00
1884....	78,670,100	2.00	143,545,400	1.50	71,860,000	2.00
1885....	86,986,184	2.00	144,528,300	1.40	71,298,300	2.00
1886....	97,076,686	1.75	161,868,500	1.30	79,272,500	1.80
1887....	105,383,172	1.75	179,609,800	1.20	86,686,000	1.50

In Cambridge, for the ten years, the increase in sales is 77 per cent., and the decrease in price 41 per cent. Lowell, increase in sales 110 per cent., decrease in price, 40 per cent.; Worcester, increase in sales 100 per cent., decrease in price, 47 per cent. The reduction in price is only one element in securing an increase in sales of gas. An enterprising and liberal management is also required.

It is a query of many consumers of gas why the price should not be as low in one place as another, where the facilities for obtaining coal and other supplies are equally favorable. It is true that the cost of gas in the holder should be governed largely by the cost of coal, and should vary according to the tariff for freights. In the twenty largest companies the cost in the holder varies from 63 to 86 cents per thousand cubic feet. But there are several other important factors which enter into the final cost of gas to the company, and which govern the price charged, that differ widely in companies similarly situated in regard to the cost of coal. These are the amount obtained from residuals, the amount paid for taxes, and the capitalization. In the twenty largest companies the amount received for residuals varies from 10 to 25 cents per thousand feet. In the same companies the extremes of taxation are 5 and 19 cents, and to pay a 10 per cent. dividend the range is from 18 to 67 cents per thousand feet. From these figures it will be seen that the company that can manufacture gas and put it in the holder at the lowest cost may not be able, on account of other conditions, to sell gas as cheaply as another company whose gas is put in the holder at the highest cost, but which is fortunate in the sales of residuals, low taxation and small capital. The subject of capitalization has been discussed in previous reports, but it cannot be too strongly impressed upon the companies that an over-capitalization, or watered stock, is a perpetual and unjust burden upon consumers. The capital necessary for the business should be used, and no more. The stockholders of a company are only entitled to fair and reasonable dividends on the actual amount of cash they have paid in. The money used in the extension and improvement of the plant, if paid out of surplus earnings, should not be capitalized, but should be for the benefit of consumers in reducing the price of gas. With few exceptions, the companies in this State are conservative in the amount of their capital, and the stockholders are satisfied with reasonable dividends.

Experiments with Gas Motors.

In a paper by MM. Salanson and Debucy, read before the French Gas Association, the authors come to the following conclusions, as the result of their experiments:

As we increase the percentage of gas in the cylinder we find first no explosion, then explosion and a gradually increasing amount of work done with a maximum at 16 or 18 per cent. of gas, then a falling off in the work done, and ultimately no explosion. On the other hand, the consumption of gas per horse power per hour increases constantly with the percentage of gas, and this the more so the more the gas mixture is compressed. Therefore, use the weakest mixture convenient, and attend to this rule more diligently in compression engines.

What is the least proportion of gas which will make an explosive mixture? If the gas and air have been carefully mixed, the gas must be 8 per cent.; if the gas be rushed in and ignited, the average percentage may be as low as 6. From this it would appear that the richest portions ignite and set fire to the poorer, which would not have ignited directly, and that there is a want of homogeneity in such a mixture so produced. The inrush of streams of gas would produce, not homogeneity, but whirlpools.

As to the residues of the previous combustion: these cause variations in the speed of propagation of flame, and irregularities in the distribution of the gaseous mixture; and the residues in the cylinder produce irregularities in the combustion, and shocks, visible in the diagrams. Hence the access of the gases should be such as to prevent whirlpools.

The ignition should start from an orgin of a perceptible size.

As to the influence of the walls: the walls should be warm, and therefore the gaseous mixture should be heated beforehand and compressed; and conversely, in order to keep down the temperature of ignition the same rule as was given above applies—namely, that the mixture should be weak.

The phenomena in the cylinder lie between detonation and combustion, but are nearer to detonation. Nitroglycerine, etc., explode most forcibly when they are warm, hermetically enclosed, and subjected to compression. In a closed cylinder flame will explode nitroglycerine, while in the open air it would not do so. This is analogous to Maillard and Le Chatelier's experiment. They found that a long tube of explosive gas mixture would explode if kindled at the closed, but might merely ignite if kindled at the open end. This would explain the weaker portions of a non-homogeneous mixture being explosively ignited on the combustion of the richer portions. In much the same way black powder produces detonating and shattering effects, as Drinker found, if it be ignited with the aid of a small charge of dynamite.

Gas-Fired Boilers.

A correspondent of the *Iron and Coal Trades Review* (England) gives the results obtained in England and Wales with boilers fired with producer gas. The producer which he regards as the best is the Wilson, of which he says: The gas producers are entirely separate from the boiler, to which the gas is conducted underground through large pipes. They may be erected singly or in groups, just as the boilers may. They are better arranged at such a level with regard to the railway siding of any works, that the tops of them are about level with the rails. The coal can then be tipped upon the upper platform, and but little labor is required to spade it into the hoppers. By the time it has passed through the producers everything combustible has been turned into gas, and the residue, which is pure ash, and which amounts to from 5 to 20 per cent. of the original weight, according to the quality of the coal, has then only to be lifted into wagons placed on a lower level, and taken away to the rubbish tip. The gas leaves the producers at a point just below the upper platform, then passes downwards through a vertical tube, and along underground till it enters a horizontal pipe passing across the front of the boilers. From this pipe it rises in vertical branches, one of which is necessary for each furnace or combustion chamber.

By far the most convenient form of boiler for using gas is the Lancashire boiler, which is set horizontally in brickwork, and has two flues studded with conical tubes. The tops of the vertical branches, rising from the underground gas main on one side of each furnace, are formed into cylindrical valves in such a way that if the fire doors are at any time open, that very operation shuts off the gas until they are again closed. The whole arrangement is exceedingly simple, neat and cleanly. The only stoking required is at the gas producer, where, as no coal has to be lifted or thrown, but merely raked or spaded into a hole in the floor, far less labor is required than ordinarily. One man, indeed, at the producer platform, can fire for at least double the number of boilers that he would be able to fire for if using the coal direct. There is no alteration in the seating of Lancashire boilers required to adapt them for gas. It is simply a question of erecting the producers and connecting the pipes.

Not less than 50 gas-fired boilers are now at work in Great Britain, and the system seems to be rapidly extending. There is no doubt that the wear or tear of boiler itself is considerably reduced by the employment of gas instead of coal. The speed of evaporation is also greatly increased, and there is an entire absence of smoke.

A series of four trials of such boilers were recently made at a colliery near Wrexham, in North Wales. Each trial lasted from 11 to 14 hours. The pressure of steam was 50 pounds per square inch. The producer gases were analyzed, and it was found that the proportion of carbonic acid in them was 5.6 per cent. In the escaping gases the carbonic acid was 15.6. The temperature of the waste gases on leaving the boilers was 500° F. The net quantity of water evaporated from 212° averaged 10.6 pounds—certainly a very excellent result.

The objection may obviously be made that firing with gas involves more apparatus than firing with coal direct; but to compensate for this there are the advantages of complete combustion of whatever quality of coal may be used, of obtaining from it all the heat that there is in it, of being able to burn coal so inferior in quality that it could not be used as a steam coal in the ordinary way at all, and so of saving a considerable percentage of the ordinary cost of steam raising.

Correspondence

[The JOURNAL is not responsible for the opinions expressed by correspondents.]

A Patent and Its Value!

NEW YORK, May 4, 1889.

To the Editor AMERICAN GAS LIGHT JOURNAL:

Apropos of Mr. Humphrys' remarks in your last number for April, p. 565, on the "New Gas Economizer," the following extracts from the inventor's patent specification are self-explanatory:

My improvement consists in forming an auxiliary gas conduit around a gas meter, said conduit connecting on the one side with the gas service pipe and on the other with the house supply. By this means more or less gas may be passed through the auxiliary conduit or economizer, and the trouble and formality of passing all the gas through the meter may be avoided, thereby producing a considerable reduction in gas bills. In carrying my invention into effect I prefer to connect the economizer with the gas service and house supply pipes at points conveniently removed from view, and to carry the auxiliary conduit behind brickwork, plaster or some other non-transparent intercepting material, as there are obvious reasons why the said conduit should not be exposed. By the use of my improved intercepting device the eyesore of an excessive amount of gas piping is avoided. The exposure of the auxiliary gas conduit might furthermore lead to unpleasant relations between the consumer and the gas company. As my improved device not only reduces the amount of gas bills, but at the same time increases the consumption of gas, it is bound to have, if generally adopted, a marked effect on the business of gas companies. A further advantage of my improvement is that the wear and tear on meters is diminished. It will also be evident that by the use of my improved economizer smaller meters may be employed. As the meter item is an important one with gas companies, these advantages will be seen to be considerable.

What I claim as my invention is:

"1.—The method of effecting reduction in gas bills, which consists in passing a portion of the gas consumed through an auxiliary gas conduit around the meter in place of passing the whole of the gas through the meter, substantially as described.

"2.—The combination in a gas economizer, of an auxiliary gas conduit passing around the meter and connecting the gas service pipe with the house supply, together with an intercepting device to cover the auxiliary gas conduit, substantially as described."

In his prospectus the inventor says: "The gas meter has for years been a cause of dissatisfaction to consumers, and has been considered one of the great difficulties in the way of low gas bills. This difficulty is now surmounted, and we are at length enabled in a very literal sense to 'get 'round' the meter. * * * As many of our clients do not, for obvious reasons, care to employ ordinary gas fitters to fit up the economizer, we have a corps of *reliable* men whom we send out on this work, and can arrange when desired to do the necessary fitting *at night*."

The inventor is at present in *Canada*. MENDACIUM MAGNUM.

The Market for Gas Securities.

Consolidated sold off a trifle during the week, but the range was less than 1 per cent. Equitable is up two points and will go higher. No change in Mutual; although it is safe to say that any change in it will be in the direction of higher prices. In Brooklyn shares the topic for the day, as in fact has been the case for the past two months, is the scheme to secure control in the Citizens Company, by Mr. Chas. G. Francklyn and associates, the latter it is said, being English and German capitalists. The agent in Brooklyn for the purpose of securing control is Mr. C. E. Staples, of Cyrus E. Staples & Co., local brokers, and he now asserts that 30,100 shares (just in excess of those necessary for control) have been turned to I. B. Newcombe & Co., of 54 Wall street, who in turn hold them for the syndicate. The par is 20, and the amount invested by the syndicate for control is $451,751, or a trifle in excess of 75 cents on the dollar. We have little doubt but that this is authentic, and we further believe that the Francklyn party have made a good purchase. Their investment is worth the money, even for fighting purposes, and it needs not a wiseacre to predict that Brooklyn gas matters will ere long take on a lively character.

The Macon (Ga.) contest has been settled by the sale of the Macon Gas and Water Company to the opposition, the capital in the deal having been supplied by Mr. Geo. F. Work, of Philadelphia, who is virtually the American Gas and Water Works Construction Company of that city. Those in control are: President, B. Van Steenbergh; Secretary and Treasurer, Geo. F. Work; Engineer, Capt. J. W. Wilcox, who did such good work under the Boardman regime. Mr. Arthur E. Boardman, than whom no more careful Manager nor accomplished gentleman is in the ranks of the fraternity today, will devote his future to the development Jeter and Boardman Gas and Water Association, and while we sincerely regret his relinquishment at Macon, we imagine that his old-new occupation will bring him more prominently before the gas world than ever. The St. Louis deal is virtually completed.

At a recent sale of New Bedford (Mass.) gas, 10 shares brought 150¼. At the annual election of the Cincinnati Company no change was made in the management; but why should there be? The annual election of the Jersey City Company will be held on Monday next.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,

16 Wall St., New York City.

May 13.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	88⅛	—
Central	500,000	50	—	—
" Scrip	220,000	—	47	57
Equitable	4,000,000	100	113	122
" Bonds	1,000,000	—	113	115
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	116	118
Mutual	3,500,000	100	102	103
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern	125,000	50	30	—
" Scrip	108,000			
Yonkers		50	90	100
Richmond Co., S. I.	346,000	50	—	—
" Bonds	20,000	—	—	—

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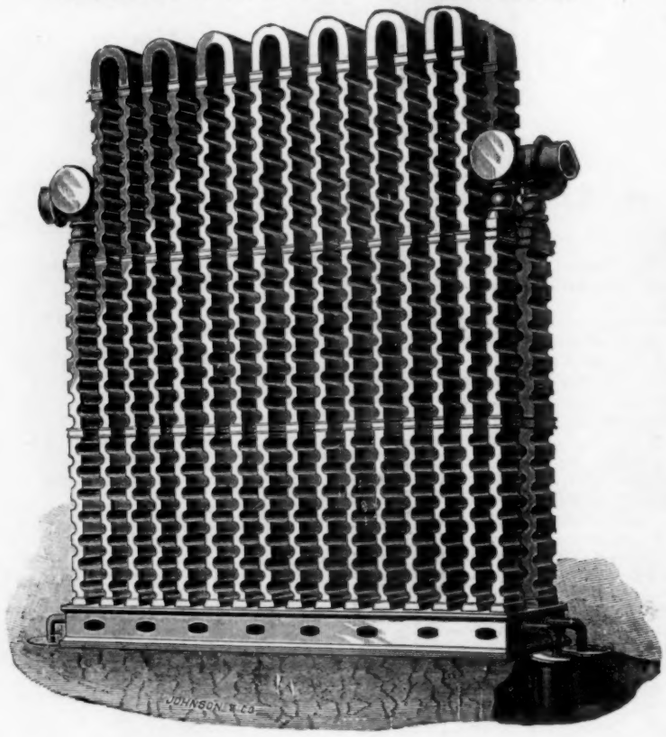

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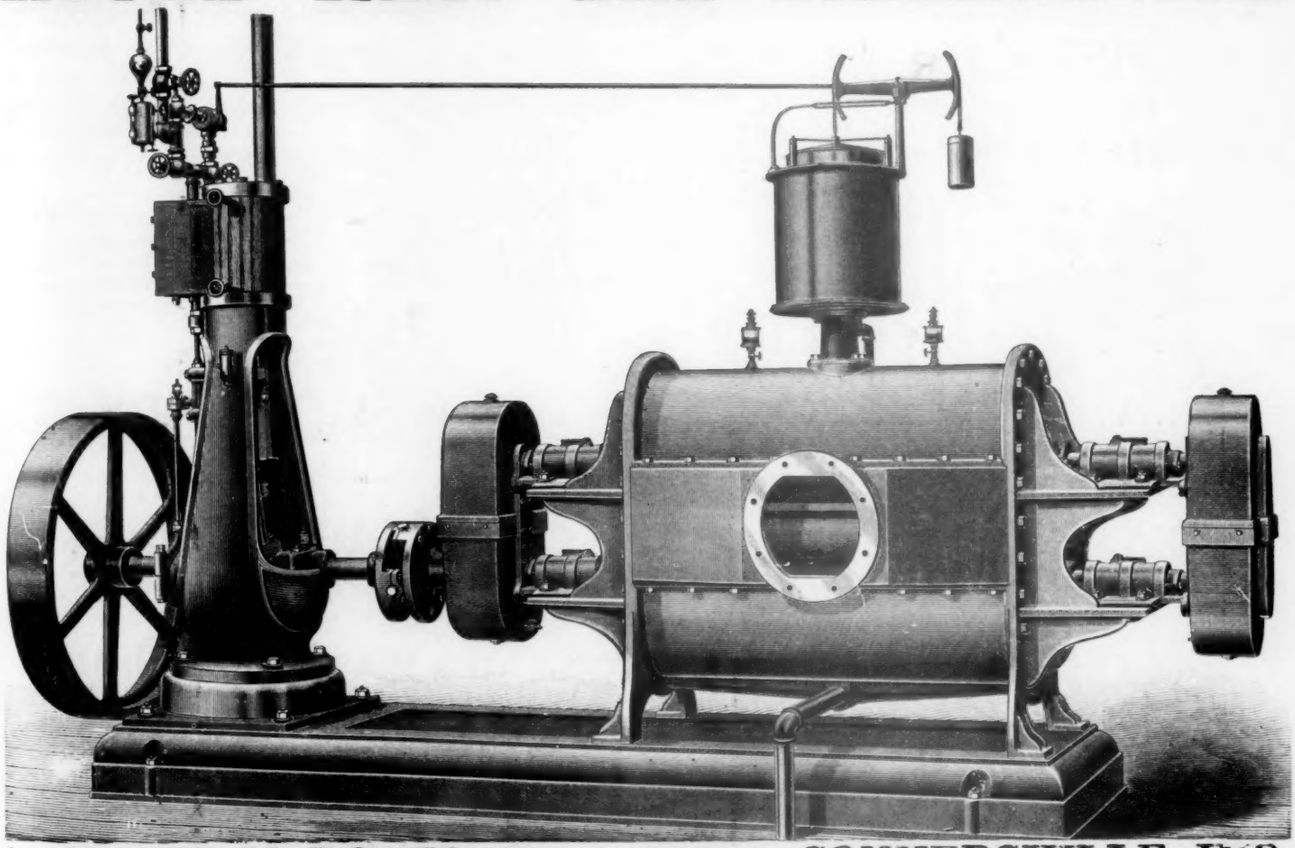

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A very general demand exists, in both large and small Gas Works, for an apparatus that will be absolutely efficient in the removal of the tar which passes the hydraulic main and condenser. Many attempts have been made to accomplish this, but, I believe, without success, until the introduction, five years ago, in England, of the C. & W. Walker Patent Tar and Carbonic Acid Extractor. During these years this apparatus has been adopted by many of the most prominent Engineers, not only in England, but also on the Continent of Europe and in other parts of the world. It is only necessary to give here a partial list in order to convince any intelligent American Gas Engineer that this machine must have succeeded fully in accomplishing the desired results.

The following Engineers have personally given permission to refer to them:

G. C. Trewby, Esq., Engineer-in-Chief of the Gas Light and Coke Co., London. The manufacturing plant at Beckton is built in complete sections of 3,000,000 cubic feet capacity each. A Walker Tar Extractor has been fitted to each one of these sections. This was done after a long and thorough trial on one of its sections. The Tar Extractor has been supplied to other works of the Gas Light and Coke Co., including those of which John Methven, Engineer of the Gas Light and Coke Co. at the Nine Elms Station, is in charge. Also to G. E. Stevenson, Peterborough Gas Works; B. Green, Mitcham and Wimbledon Gas Works; W. H. Smith, Bedford Gas Works; F. Linging, Norwich Gas Works; J. T. Browning, Colchester Gas Works; S. B. Darwin, Portsmouth Gas Works; J. McCrae, Dundee Gas Works; W. J. Wells, Stamford Gas Works; J. M. Darwin, Longton Gas Works; J. Paterson, Warrington Gas Works; and J. Coulter, of the Dundalk Gas Works. All of the foregoing gas works are located in Great Britain.

Mr. Charles A. Gerdenier, Superintendent of the Bridgeport (Conn.) Gas Light Company, writes as follows, under date of Dec. 3, 1887:

"The C. & W. Walker Tar and Carbonic Acid Extractor has been in operation at these works for the past six weeks, and is an unqualified success. It removes every particle of Tar from the gas in once passing through the apparatus, and a large percentage of the Carbonic Acid. I also feel quite sure that it prevents the formation and deposit of Naphthaline, because since I started the Washer I have had no stoppages from this cause. These works have been seriously troubled with Tar for many years, and I have used several kinds of apparatus and every expedient which has come to my attention for dealing with the difficulty, but without success. The Walker apparatus occupies comparatively small space, is less expensive than other systems, and requires but little attention. I carry 2½-inch seal, and have an automatic tar delivery valve. This Tar Extractor is indispensable to gas makers."

I have taken the Agency for the United States for this apparatus, and am now prepared to make contracts to erect it on the premises of any Gas Company. It would be manufactured in the following sizes:

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No. 3,	"	"	250,000	"	"	"	5	"	"	"	"
No. 4,	"	"	500,000	"	"	"	6	"	"	"	"
No. 5,	"	"	750,000	"	"	"	7	"	"	"	"
No. 6,	"	"	1,000,000	"	"	"	8	"	"	"	"
No. 7,	"	"	1,250,000	"	"	"	9	"	"	"	"
No. 8,	"	"	1,500,000	"	"	"	10	"	"	"	"
No. 9,	"	"	2,000,000	"	"	"	12	"	"	"	"
No. 10,	"	"	3,000,000	"	"	"	15	"	"	"	"

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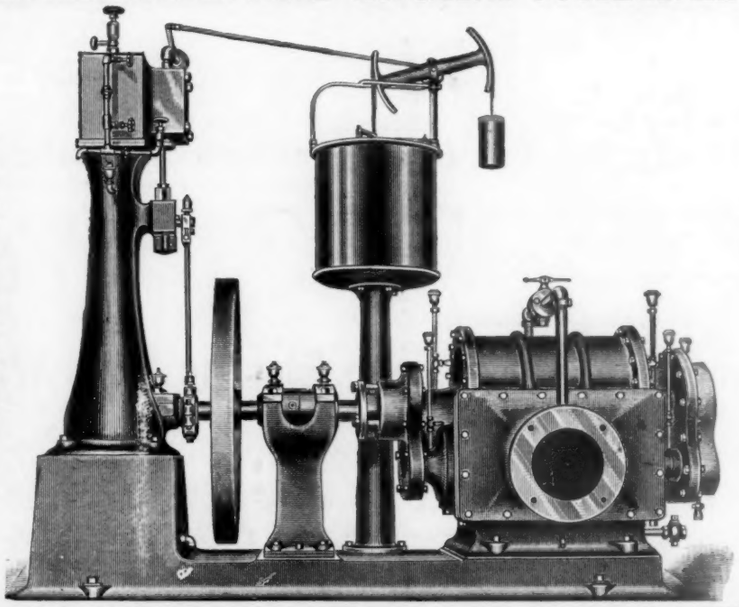

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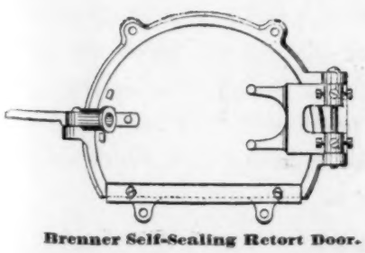

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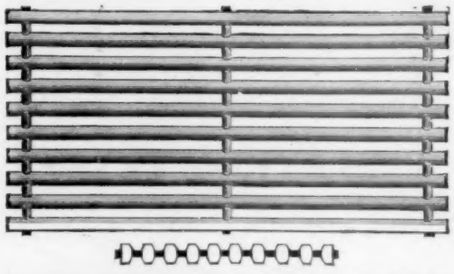

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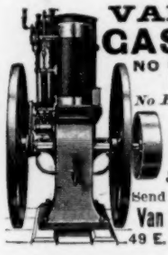

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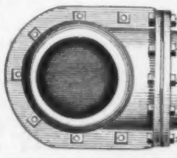

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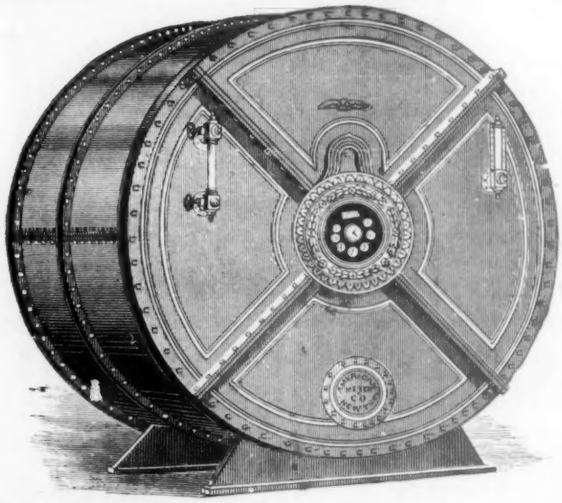

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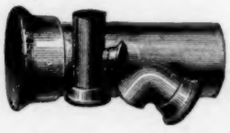

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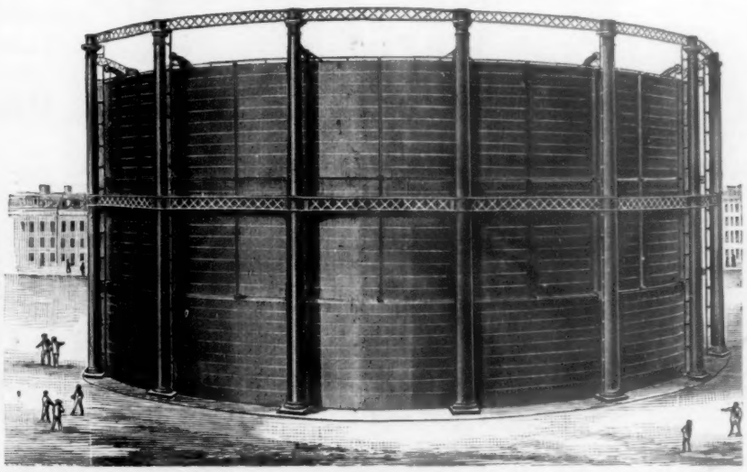

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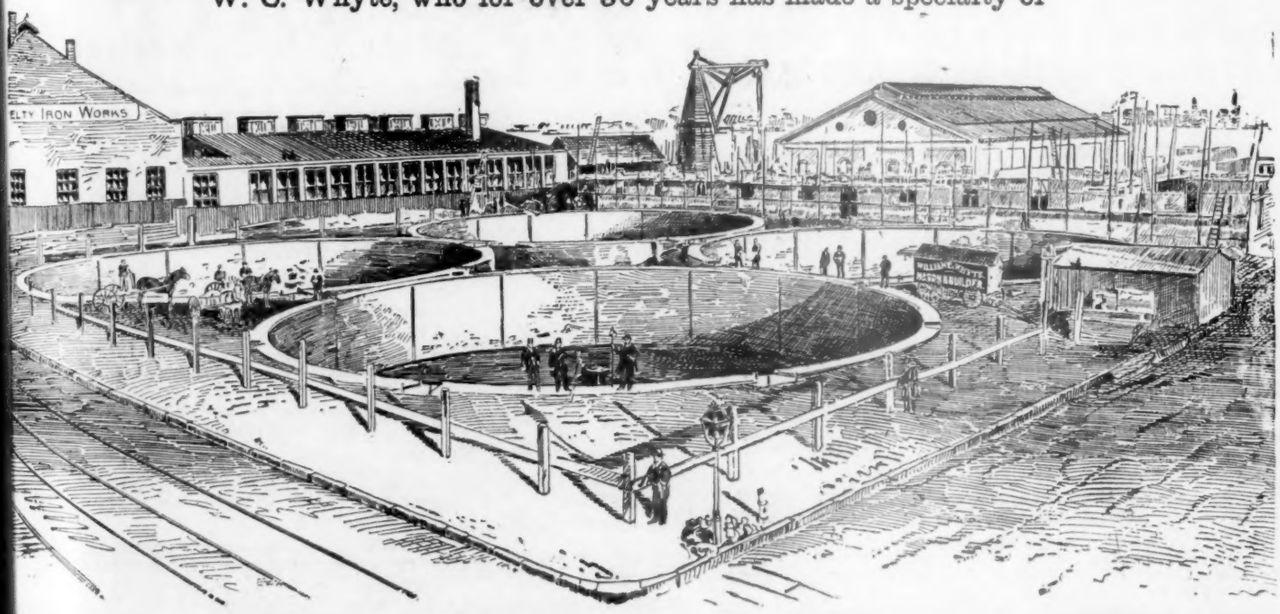

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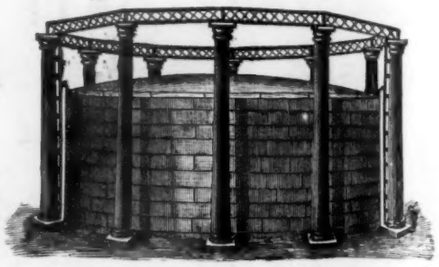

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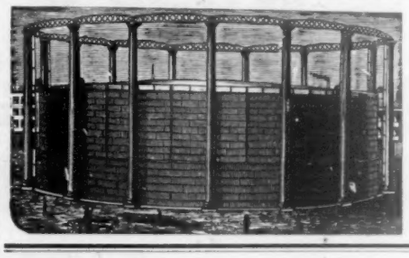

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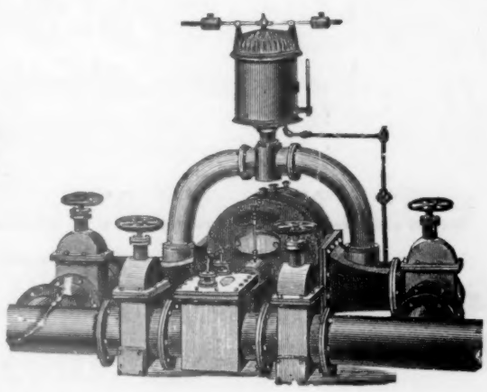

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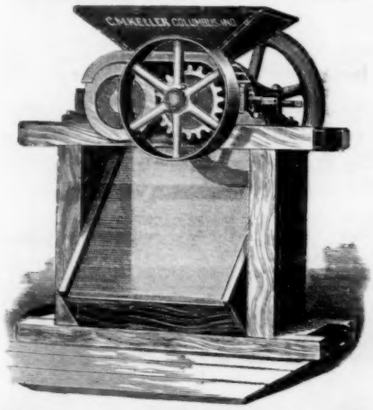

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DRY CENTRE VALVES. CRESSON GAS REGULATORS. AMMONIA TEST METERS.
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GAS STOVES,
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WET AND DRY GAS METERS, STATION METERS, EXPERIMENTAL METERS, METER PROVERS,

Center Seals, Pressure Registers, Governors, Indicators, Photometers, and all other kinds of Apparatus for use in Gas Works.

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REPAIRING DEPARTMENT.—We employ a special force of skilled workmen repairing meters of **all makers.**

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MANUFACTURERS OF THE "SUN DIAL" GAS STOVES, FOR COOKING AND HEATING PURPOSES.

Dry and Wet GAS METERS, Station Meters (Square, Cylindrical or in Staves) Glazed Meters, King's and Sugg's Experimental Meters, Lamp Post Meters, Etc., Etc., Meter Provers (sizes 2, 5 and 10 feet), Pressure Guages of all kinds, Pressure Registers, Pressure and Vacuum Registers, Pressure Indicators (sizes 4 inch, 6 inch and 9 inch), King's Pressure and Vacuum Gauges, Dry and Wet Centre Seals, Dry and Wet Governors, Exhauster Governors, Photometers of all descriptions. Letheby's Sulphur and Ammonia Test Apparatus complete—also Testing and Chemical Apparatus of all kinds, and of the most perfect description, for all purposes relating to Gas.

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Special attention to repairs of Meters, and all apparatus connected with the business.
All work guaranteed first class in every particular, and orders filled promptly.

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GAS METER MANUFACTURERS.

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STATION METERS, EXPERIMENTAL METERS, METER PROVERS, PRESSURE & VACUUM REGISTERS, PRESSURE GAUGES, ETC.

Also STAR GAS STOVES, RANGES, and HEATING STOVES.

We use only the very best materials, and employ the most skilled labor, and by our long experience (32 years) and personal supervision of every detail, we feel justified in assuring the public that our goods will give perfect satisfaction. Every Meter emanating from our establishment will bear the State Inspector Badge, and will be fully warranted by us. Our Annual and Calendar will be sent to Gas Companies upon application.

GAS STOVES. GAS STOVES. GAS STOVES.

THE GOODWIN GAS STOVE AND METER CO.,

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SOLE MANUFACTURERS OF THE

"SUN DIAL" GAS STOVES,

The Most Economical, Efficient, and Durable Gas Stove Made.

GAS COOKING STOVE, No. 8 C.

SIZE.

Stove.	Oven.	Roaster.	Top.	Length over Extension Shelves,
37 in. high.	12 in. high.	12 in. high.	24 in. long.	36 in.
20 in. wide.	17⅛ in. wide.	18 in. wide.	21 in. wide.	
	12 in. deep.	13 in. deep.		

This Stove has four burners on top, and double oven burner.

Consumption of gas with all burners in use, 42 feet per hour, at 1 inch pressure.

The top is made in sections, so that a greater variety of cooking utensils may be used. By lifting out the covers and crosspieces and putting in a suitable forked ring, which is sent with each stove, a wash boiler or other large utensil may be set over two burners. Our **No. 87 GRIDDLE** also fits in the same position. The roasting oven is provided with a cast iron door.

All Fittings are Nickel-Plated.

GAS COOKING STOVE, No. 7 B.

SIZE.

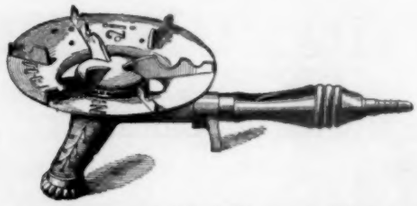
Stove.	Oven.	Roaster.	Top.	Length over Extension Shelves,
31 in. high.	9¼ in. high.	10 in. high.	21 in. long.	32 in.
17 in. wide.	14¼ in. wide.	15 in. wide.	16 in. wide.	
	12 in. deep.	13 in. deep.		

This Stove has three boiling burners in the Top or Hot Plate, and one single oven burner.

This cut represents our New Style Cooking Stove. As will be seen, it has an ornamented cast-iron Base and Front, and extension shelves. The Oven Burner, which is atmospheric (unless otherwise ordered), is of an entirely new and improved pattern (patent). The ovens are of greater capacity than those of the old style. The Top, in conjunction with the Outlet Pipe, is designed to carry off all the products of combustion, if desired, but they are also supplied with a loose ring which converts it into an ordinary open top stove.

The consumption of this Stove is 35 cubic feet per hour at 1 inch pressure, with all Burners in use.

All Fittings are Nickel-Plated.



"RADIANT" BOILING STOVE, WITH REGENERATIVE BURNER.

Size, 6¼ inches diameter, 3 inches high. Consumption, 6 feet per hour at 1 in. pressure.

HOT PLATE, No. 111.

Size, 36 in. long, 12 in. wide, with three double burners, 6 taps.

Consumption, with all burners in use, 36 cubic feet per hour, with 1 in. pressure.

½ in. supply pipe should be used where the pressure is 1 in. or over.